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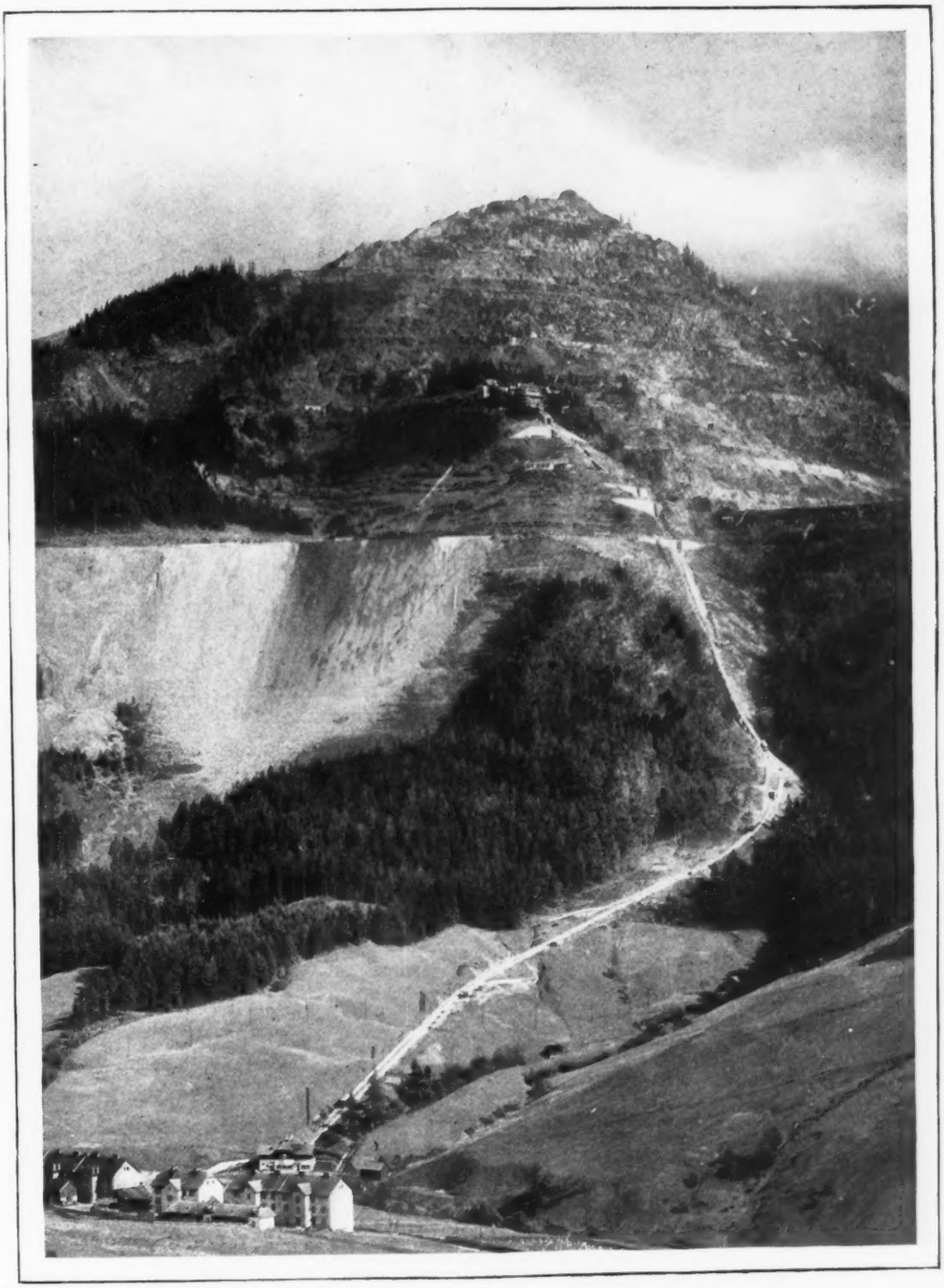

Prospecting by the Earth Wave Travel Method

By Karl L. Kithil

Operations at the Britannia Mines

By James I. Moore, Jr.

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Mining Stocks

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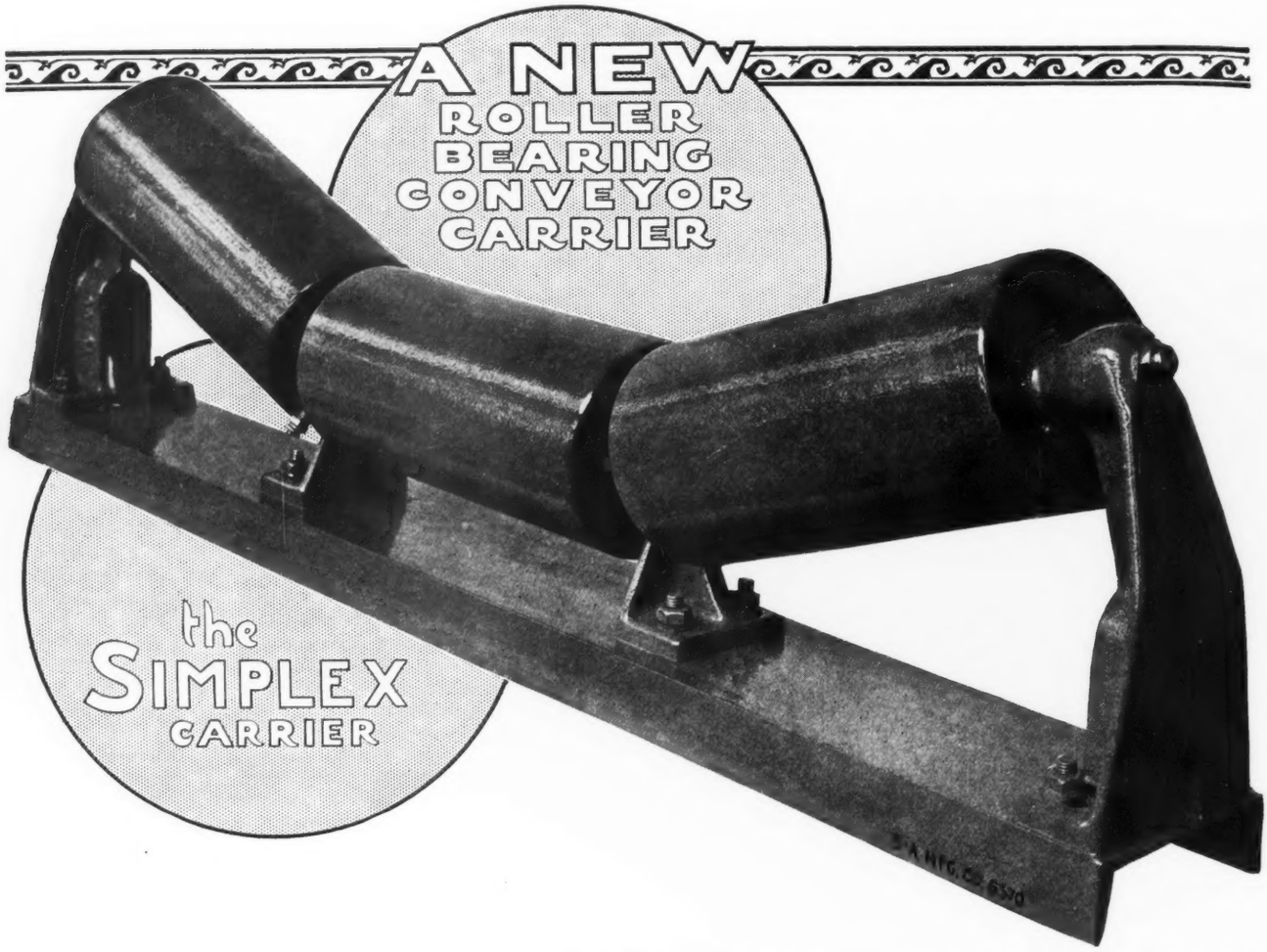

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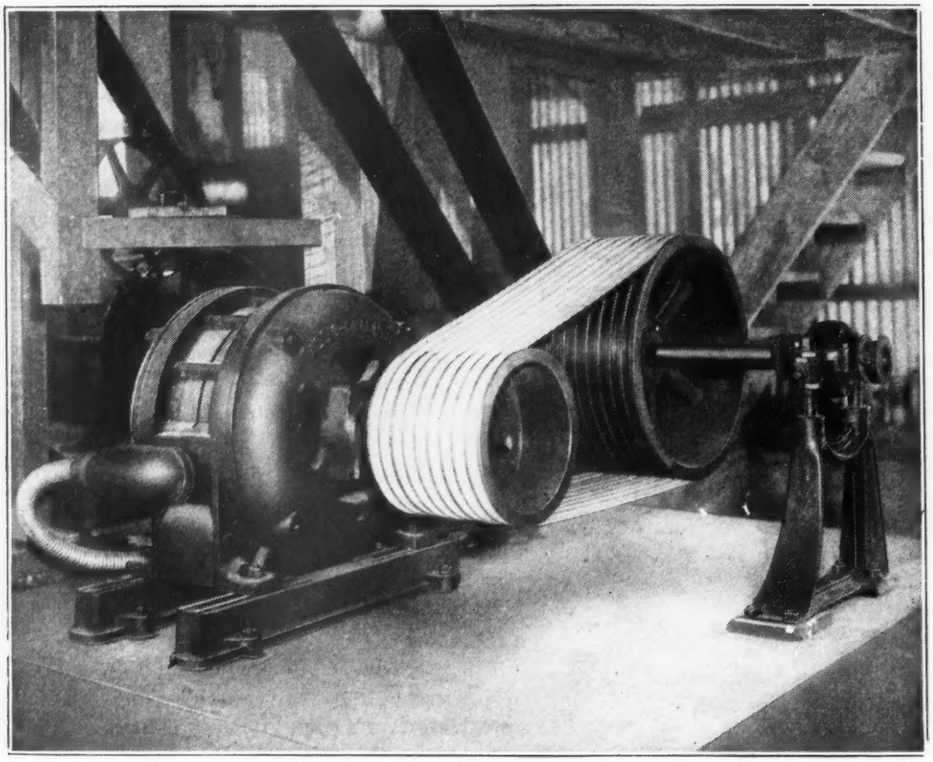

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ENGINEERING AND
MINING JOURNAL

JOSIAH EDWARD SPURR, Editor

Volume 122 New York, December 11, 1926 *Number* 24

The Demand for Industrial Raw Materials

THE PRODUCTION of raw materials has reached unprecedented dimensions, with no signs of diminution. Bituminous coal, after a long period of depression, has beaten all records. Copper and other industrial metals are at high peaks of production. Nor is there any reason to believe that this situation is inflated and bound to be followed by a corresponding depression. Europe is steadily improving its position economically, and with that its capacity of buying, and its determination to greater industrialization. While the consumption of automobiles, for example, has increased in the United States to numbers which were formerly considered unbelievable, a similar increase in Europe would provide markets for almost limitless further consumption. As it is, an astonishingly large proportion of the produced quantity of many metals goes into automobiles. There are more automobiles than telephones in the United States; and an illuminating and amusing bit of statistics tells us that every time a telephone rings an automobile travels seven miles. The United States, Secretary Hoover tells us, is at a peak of prosperity, as to production, consumption, standard of living, and the rest. If this be not true of each individual reader who peruses this, let him comfort himself that statistics assure him it is true in general; and warm himself with that conviction. Europe still feels most the impoverishment created by the World War, but is clearly and rapidly "muddling through," and seeking and finding new means to advance. The prosperity of Europe will not decrease that of the United States; it will provide new markets for the products of the highly mechanicalized industries and for raw materials.

Deposits of industrial metals should be more and more in demand; in general the price of industrial metals should tend to gradually advance. Now is the time for far-sighted individuals and organizations, who have capital and can afford to pay a little in taxes and lost interest on capital, to acquire large deposits of metals like copper, tin, lead, and zinc, which deposits are not quite rich enough to repay working under the present conditions. The time will come when they can be operated profitably. Tin is the metal which is being sought most urgently at the present time; and, next, large and permanent supplies of lead. But the other metals will have their turn, and the prices will have their advance. Substitutes, it is true, will be found for many of these metals: the chemists are busy and enthusiastic, although the alchemists, who are to transmute one metal into another, have not been heard from for a long time. Many of the synthetic processes of the chemist and chemical engineer, however, are practical and adequate for many purposes: so that actual disappearance from the world's markets of an adequate supply of a given metal will probably be ingeniously provided for, by some substitute. But the major metals, so long as they can be supplied reasonably—and that is the outlook for a long time—remain the cheapest and best of raw materials for most industrial purposes, and in some cases it will be a hard task to find substitutes for many of their uses.

The increase in demand, and the consequent improvement in price, together with new methods of more economical and efficacious mining and reduction, will bring into production, in the United States, many deposits which have been neglected on account of their average low tenor; and will result in the reopening of some mining districts. Premature efforts of this kind, on too small a calculated margin of profit, are, however, unwise. It is inviting trouble to go into an expensive enterprise in mining and reduction on too small a theoretical margin of profit. The gold mines at Juneau, Alaska; the concentrating iron ores of the Mesabi; and the recent attempt to revive the Comstock are all examples of this. And, indeed, gold and silver mining in general must be excepted from the forecast of a gradual advance in price made for the purely industrial metals.

African Coppers

BWANA M'KUBWA, in Rhodesia, is at last getting under way. Though by no means comparable in extent with the Katanga copper deposits a few hundred miles to the north, a large tonnage of oxide and silicate ores has been found, to be mined at the surface by steam shovels. The treatment consists in heating, reducing with producer gas, leaching with ammonium carbonate solution, precipitating the copper as oxide by driving off the ammonia with steam, and reducing the oxide to pure copper in a reverberatory furnace. Minerals Separation developed the process, with the able assistance of America's ammonia leaching authority, C. Harry Benedict, metallurgist of the Calumet & Hecla company. The initial production of 195 tons of copper was made in September, followed by 205 tons in October, and 466 tons estimated in November. December production has also been estimated at 637 tons, showing meticulous work by the company's estimator! As is usual with new properties, even where success is reasonably assured, cold cash for expansion is none too plentiful, so Bwana M'Kubwa is planning to issue 2,000,000 new 5s. shares, which it will sell, or at least plans to sell, to present shareholders for 7s. apiece.

The Union Minière du Haut-Katanga, on the other hand, is producing less than at one time. The peak of production, so far, was reached in August, 1925, when 10,165 tons was reported; the best that has been done this year was also in August, 8,188 tons; after which the production dropped to 7,623 tons in September and

6,525 tons in October. Presumably, the labor supply is being turned toward construction work in the enlargement of the leaching plant and smelter, and toward development of the Prince Leopold mine, rather than to push the current production up to the limit.

A request has been made recently that we publish the stock quotations of Rhodesian Congo Border Concession and its newly organized subsidiary, the N'Changa Copper Mining Co., this group being the third great potential African copper producer to get in the limelight in the last few years. These deposits are in course of development, and are apparently still far removed from the production stage. They are unlike the other two in that the ore is a primary sulphide, which, according to present practice, would naturally be treated by flotation and reverberatory smelting; the metallurgical problem therefore is similar to that solved so successfully by the American porphyry companies, simplified by the fact that the ore is much higher grade, perhaps 5 to 8 per cent, and complicated by the remote situation of the property in the heart of Africa.

There is little doubt that the potential production of this group of African companies is great and that at some time it will furnish a substantial proportion of the world's copper; there is just as little doubt that it is a difficult matter to attain and to expand production in the middle of Africa, and that no immediate fear need be entertained that the world is going to be flooded with cheap copper from this source, either next year or the year after.

Study of Foreign Trade

THE Department of Commerce has necessarily had to do with export and import trade as well as with domestic commerce. Trade tends to become more and more international, in spite of the efforts by tariff barriers all over the world to stem this tendency. The export trade of the United States amounted to 2½ billion dollars in 1913 and 5 billion in 1925—a marked increase, even with the necessary discount for the decreased relative value of the dollar in 1925.

The Bureau of Foreign and Domestic Commerce in its name signifies its broad activities. It has gradually built up a foreign service, sending commerical attachés and trade commissioners to foreign countries to study conditions. Some of these are permanently located; others have a special or roving commission. The State Department at one time sent over special diplomatic attachés who were principally interested in problems of trade and their bearing upon state relations. This situation created a conflict with the Department of Commerce, with the result that the field was left to the latter department.

The specific duties of the Bureau of Foreign and Domestic Commerce commissioners are thus outlined in a recent statement by the United States Chamber of Commerce: "Acting under the direction of the Bureau in Washington these men keep in constant touch with business conditions throughout the world and report promptly by mail and by cable important facts likely to influence American foreign trade. They transmit specific trade opportunities to the Washington office, make special investigations regarding the foreign markets for a wide variety of American commodities, report upon tariff changes, taxes, legal requirements, commercial standing of foreign houses, financial and investment developments, foreign activities in transportation and communication, and a great many other matters of vital importance to American overseas trade."

Owing to the gradual growth of the foreign service, it has hitherto been financed by annual appropriation. Any slight oversight, delay, or failure to make the necessary annual appropriation would result in much confusion and financial loss. It is therefore proposed, in a bill now before Congress, to make this service permanent, by the creation of a Foreign Commerce Service within the Bureau of Foreign and Domestic Commerce. The bill, known as the Hoch bill (H.R. 3858), which has been passed by the House and awaits the attention of the Senate in the approaching session, will give definite and permanent legal status to the foreign service: it would also provide for definite appointments and salaries.

The mining industry has a great interest in foreign trade, and should be a strong supporter of this necessary extension of the activity of the Department of Commerce.

The Joiners

THIS IS ABOUT THE TIME that the meetings of societies, dinners, and the gathering of committees begins to be thickest, after the mutually established truce of the long summer days. Mining and metallurgical and chemical and geological and mechanical and engineering and commercial and economic and political and college and patriotic and social organizations without number come upon the calendar to claim attention, time, and financial support: and many more varieties besides those enumerated above. The average man varies between boredom and interest in his attitude, at one time wondering why the multiplicity of these organizations so stridently calls for his energy, at another considering with a mixture of wistfulness and humor enrolling himself in yet new organizations, ancient or about to be born.

There is, perhaps, no need of positive judicial opinion, one way or the other, upon this condition. It is an inevitable and natural one; and, viewed in the proper light, a very excellent, time-saving, and efficient system. In the great and complex development of modern thought and activities, the range of any one man may not exactly coincide with that of any other. He has a common interest with Brown on one or two points only: with Jones on some other single and isolated subject or two: and so on. The system of having each interest or activity not only specialized but specially organized provides a great assortment of the most valuable tools, easily accessible to the use of everyone. Are you a mining engineer or interested in real mining? Attend the various meetings of the Institute and seek in the various committees and specialized activities that which you want to use. Do you desire to follow the philosophy of mining? The small and clubbier meetings of the Mining and Metallurgical Society in New York will help. Are you interested in the practical politics of mining and of mining legislation? Attend the meetings and share in the councils of the American Mining Congress. Do you wish an oversight of the whole field, as carefully apportioned and as judicial as can be made? Read *Engineering and Mining Journal.* Are you especially interested in mining in some section? Subscribe to your regional mining paper, if there is one. And

so on and so on: the above being but a sample of good advice which could be expanded in the case of each individual who reads this, into many related branches and societies — through the culling out of which he may easily and pleasurably be helped to as full a life as he requires. He becomes perhaps a Joiner, but a glorified type—not of secret societies, but of wide-open associations.

One practical corollary results from the wide and thorough systemization of a man's activities and interests—interests which should cover not only what he knows about but what he would like to know about—his cultural interests as well as his business and professional ones. All these things have a way of adding up in the money way, so that a man wonders whether he is not extravagant in this and whether he should not "cut down on his societies"—words so often heard that they have become a phrase. This is the poorest form of economy; but it may become necessary. Therefore the corollary is that the expense of belonging to organizations should be kept down so that the sum total shall be as reasonable as possible. Societies should not increase their dues as the easiest way out, nor should they make embarrassing demands for extra support, or make conditions for attending meetings and dinners too expensive. Economy and thrift (and as H. H. would say, the elimination of w.) should be the guiding principles. If each man will contribute something of his time to the common work it can be carried on with that minimum of expenditure which will make the system most widely useful and beneficent to him and to his fellow pioneers.

Australian Gold Fields

THE STATE of Western Australia has recently realized the fact that financial difficulties prevent any serious attempt to develop its vast northern territory. The administration of this region has resulted in a yearly loss. This large state, having an area of 975,920 square miles, with a population of about 325,000, compares with 980,053 square miles embracing Arizona, Nevada, Utah, Idaho, and Alaska, with a population of 1,340,000. The population of Nevada is 0.7 per square mile; that of Western Australia is 0.34, or only one-half the density of our most sparsely populated Western state.

A large part of the state is as arid as any of the plains of Arizona or Nevada. The annual rainfall in the extreme southwest near the sea coast is about 38 in. per year, and at Kimberley, the extreme north, the rainfall is about 20 in. per year. In the great interior and especially in the eastern part, at Coolgardie, the precipitation is less than 10 in. per year. Much of the country is even too arid for grazing purposes, and government officials seem to feel that the area embracing the Kimberley, Murchison, East Murchison, Coolgardie, Kalgoorlie, and Dundas gold fields are a liability rather than an asset.

Last May the commonwealth offered to take over the northern part of the territory and thus relieve Western Australia of $2,250,000 yearly expenditure. Whether Western Australia can accept this proposal is the interesting question which the Legislature and Parliament will make an effort to decide at the next stated session.

Wonders of Synthesis

SYNTHESIS is the opposite of analysis: the latter means disintegrating, as breaking up a chemical compound into its constituent elements: the former means integrating, as forming a chemical compound by the joining together of distinct elements. Analysis was the first triumph of chemistry and was of vast industrial importance; synthesis is the later achievement, and of even more marvelous, almost miraculous, results. In the process of synthesis it has been found that certain media may be useful or even necessary to produce a desired combination of elements, even though these persuasive elements or substances take no part in the chemical process involved, and remain at the end as they were in the beginning. These substances are called catalyzers; the function is called catalysis. Synthesis, with or without the intermediary service of catalyzers, is of present and future industrial and every-day significance—and has passed into every-day speech—as, for example, synthetic alcohol.

The achievements of the chemist in this respect surpass all that the lay imagination could have conceived. For example, camphor, a vegetal gum, and, by reason of climate, practically a Japanese monopoly, has been made synthetically on so large a scale as to displace largely, in the United States, the natural substance. Indigo, another vegetal product, has largely been supplanted in the world's markets by artificial indigo, made from coal tar. The leather industry, as statistics and graphs show, suffers apparently permanent depression, while most other industries are very flourishing. What is the reason? The manufacture of artificial leather from cellulose—not the stained pressed paper substitute that we knew in the old days in shoddy articles, but a leather about as good as the real hide—practically a real leather. Last year automobile upholstering used over twice as much artificial leather as real leather. Synthetic perfumes, which have the true odors of certain flowers, and animal perfumes, are manufactured in some cases more cheaply than the natural product. Synthetic flavorings have taken over a large part of the market of the natural vegetal product; well-known examples are vanilla and peppermint.

In the mineral world, petroleum is perhaps the only natural product which may have a synthetic rival. The production of oils from oil shales and from bituminous coal may or may not be synthetic in the exact sense—one process, that devised by Berghuis, however, is truly synthetic, combining free hydrogen with the coal under pressure, to make new hydrocarbon compounds. In the field of non-metallic mining, where minerals which are chemical combinations are used in their natural state for their physical values, artificial and in part synthetic substitutes, of course, do and will exist. In the metallic field there will be great competition from substitutes, but the field of reproduction by chemical methods is probably safe. Synthesis here is of course out of the question, since the metals are elements: and the only dream of the chemists in this connection has been the change of one element into another, the transmutation of a baser metal into a more valuable one. This, following the discovery that one element may really change to another, as uranium does into radium, and the latter into helium and lead, is not an impossible hope: but it has not yet been done, despite many manifestoes to the contrary; and as an industrial probability it seems remote.

Operations at the Britannia Mines

First Production in 1905—Aërial Transportation Replaced by Underground and Surface Electric Haulage—Ore Deposits in Shear Zones —Stoping Methods Varied

By James I. Moore, Jr.
Superintendent, Britannia Mining & Smelting Co.,
Britannia Beach, B. C.

James I. Moore, Jr.

IN REVIEWING the operations at Britannia mines, it is appropriate that the discovery and early history be noted. Various reports of the Minister of Mines[1] since 1899 contain accounts of Britannia's early as well as current history.

Seven original claims comprised the Britannia group, of which the Jane M. C. was the first to be developed, resulting in the Jane mine. These claims were located by Oliver Furry, for whom Furry Creek was named. The location of these claims was made in 1898 or earlier. In opening up the property it passed through various hands, each adding to the development and ore exposed until it became a shipper, in 1905. From that time on, the property, under various managements, continued to expand as further development increased production possibilities. More claims were added either through purchase or location, until today the property includes more than 500 mineral claims or fractions, comprising over 25,000 acres.

Productive History—Although the Britannia group of claims was located about 1898, it was not until 1905 that the mines entered the lists as producers. This was due chiefly to the fact that a large amount of capital was required to finance the construction of a concentrator and transportation and power lines. In the first years of production, two grades of ore were shipped from the mine: concentrating ore to the mill and shipping ore to the smelter. The ore was sorted at the mine after being crushed to 3-in. ring size. In 1905, the first year of production, 17,082 tons of ore was shipped. As will be seen in the graph, Fig. 4, production has increased steadily, except during years in which outside causes prevented, until in 1925 over 1,000,000 tons was mined. or a little less than one million dry tons through the concentrator.

Transportation History—The transportation of Britannia ores to tidewater involved quite a problem, for, as in all low-grade properties, quantity production is necessary for appreciable profit. The Jane deposit, first to be exploited, lies 3 miles, direct line, from tidewater, and 3,500 ft. above sea level. The first means of transportation was by aërial tramway. This tram was completed in 1905. The tramway was 16,800 ft. long, in two sections, with an angle station. The upper section was 5,800 ft. long, overcoming 1,400 ft. in elevation in this distance, and the lower section 11,000 ft. long, dropping 1,800 ft. in elevation in this distance to the mill. The upper section of the tramway was particularly difficult to operate in winter, as its location was along a side hill and therefore subjected most severely to weather conditions.

Owing to the limited capacity of the tramway, a maximum of 800 tons per day, and an economic necessity for an increase in production, plans were got under way in 1912 for an improvement in transportation, that ultimately resulted in abandoning the aërial tramway. These plans involved the driving of a 4,500-ft. tunnel, at an elevation of 2,100 ft., connecting ore pass and shaft to the workings of the mine, 1,200 ft. above; the construction of a 3½-mile narrow-gage electrically operated switchback railroad on a 3 per cent grade from the portal of the new tunnel to a point 1,500 ft. above and overlooking Britannia Beach; and the construction of a 15-deg. incline, 1⅛ miles in length to the receiving bins at the mill. These plans were completed in 1915. Before the completion of the plans, however, the disastrous snowslide in March, 1915, destroyed the upper terminal of the tramway, necessitating the immediate construction of a new upper terminal above and across Britannia Creek from the angle station. With its completion, ores were transported over the upper portion of the new railroad from the ore pass in the 2,200 tunnel to the upper terminal and thence over the lower section of the tramway to the beach.

A still further improvement has been made over the incline and tramway routes, by dropping the ore by gravity to the elevation of the mill through a long ore pass. This improvement involved driving the 4,100-level tunnel—elevation 260 ft. above sea level—some 4,000 ft., from which a raise on 65 deg. slope was driven 1,500 ft. to the Armour tunnel, which is connected with the railroad. At present all ore is handled by gravity by various routes to the main ore passes, from which it is loaded into 20-ton railroad cars, hauled 3½ miles to the head of the above-mentioned raise, discharged, and drawn out on the 4,100 level into 15-ton cars for transportation to the mill bins. The aërial tramway is not in operation, but is held in readiness for use should any emergency arise or should it be desired to ship and treat one kind of ore separately from the general production. Each of these stages of improvement has resulted in material reductions in transportation costs.

One further improvement is now under way, which will make a further reduction in costs. Near the portal of the Armour tunnel, where the ore is now discharged into the 4,100 raise, and at the same elevation, is the 2,700 tunnel, which was driven 3,600 ft. in 1917-18, headed toward the mines. The 2,700 tunnel is now

[1]The account contained in Report of Minister of Mines for year 1924, p. 229, compiled by W. M. Brewer, resident engineer, seems to be the best and most comprehensive.

being extended 6,300 ft. to connect with No. 3 shaft, which is being sunk in the Bluff mine. A rock raise connection will be made between the 2,200 and 2,700 levels and all ore will be passed through this new route, making it then possible to dispense with ore transportation over the Tunnel railroad. This new transportation improvement will make possible the handling of all ore to the beach entirely underground, a great contrast to the entirely aërial transportation of 1905.

Geology of the Britannia Area

The ore deposits of Britannia lie in a shear zone which has been traced for six miles on its strike, varying in width from 500 to 1,000 ft. The strike of the zone averages S. 70 deg. E., and the shearing planes have an average dip of 65 to 70 deg. to the south. There are five developed and productive deposits within a length of 7,000 ft. along the strike of the shear zone, this constituting the productive area of the property at present. These deposits are separated by 500 to 1,500 ft. of barren ground, and have been designated as separate mines, although each is connected underground with its next neighbor.

In the order of discovery and also successively from west to east along the zone the mines are called Jane, Bluff, Fairview, Empress, and Victoria. A sixth deposit, 6,000 ft. east of the Victoria, is being developed at present. Each of the deposits has distinct geological structure of its own, and it will be in order to treat each separately.

Jane Mine—The Jane orebody is distinct from the others in that it lies within rock of sedimentary origin. Shearing is not present to any marked degree, although the deposit lies within the shear zone. The orebody is massive, siliceous, and very irregular, indicating that the deposition occurred as a siliceous replacement of the original sedimentary rocks. The body is roughly 250 ft. in width by 300 ft. long, and extends from the surface, elevation 3,400 ft. above sea level, to the 1,100 level, at an elevation of 3,175 ft. Within the deposit there are three distinct zones of concentration, separated by low-grade siliceous gangue. Two of these zones have produced the entire output of the Jane. The first year of production in this mine was 1905, and the mine continued for a few years as the only producer from Britannia mines. The Bluff and Fairview deposits then presented greater possibilities, and the Jane was discontinued, not having been productive since.

The minerals contained in the Jane deposit include chiefly pyrite, zinc blende, chalcopyrite, and a little galena, quartz, gypsum, calcite, and barite. Gold and silver values vary greatly, some assays having been recorded as high as $30 per ton, although the general average seems to have been from $1 to $2 per ton.

Bluff Mine—The Bluff deposit, like the Jane, is massive and irregular, with no noticeable shearing, but is entirely in rocks of igneous origin. The footwall is a well-defined gouge or crushed zone, 15 ft. or more in thickness, containing a pronounced quantity of gypsum. Behind this there is the main slate footwall which bounds the orebodies on the north. The hanging wall of the Bluff deposit is an unsheared quartz porphyry, differing from the main orebody only in its mineral content. In depth, the hanging wall is sheared, forming a green chlorite schist. To the east and west, the Bluff orebodies grade into an unsheared quartz porphyry. The Bluff deposit at higher levels lies 900 ft. easterly from the Jane, although in depth, owing to the pitch westward, the ore is vertically below the Jane mine. The deposit tops at the surface just above the 1,000 level, elevation 3,400 ft., and extends to a developed depth of 1,300 ft. to the 2,200 level, elevation 2,100 ft., and diamond drilling has shown it to extend 500 ft. below, with possibilities of even greater extension in depth. However, this is not continuous, as the deposit consists of two distinct units, separated on the 1,400 level by 300 ft. and merging into one near the 2,000 level. The east unit on the 1,200 level covers an opened area 500 ft. by 250 ft., while on the 1,400 level this area is less, but is enhanced by an additional area 300 ft. by 150 ft.

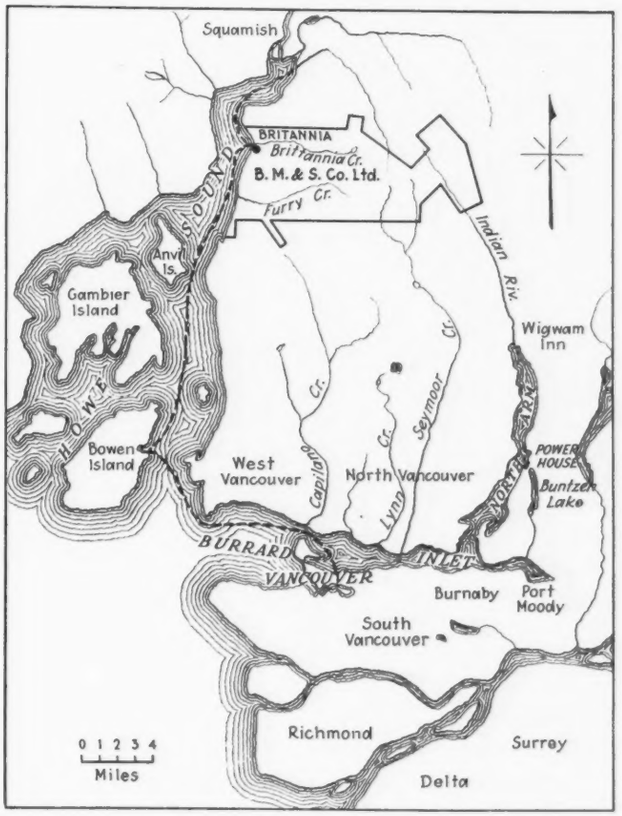


Fig. 1—Sketch map showing location of Britannia property

in the west unit. On the 2,000 level, where there does not appear to be any distinction between the east and west units, there is an area now developed more than 500 ft. long by over 100 ft. in width. Further development of this level as well as the 2,200 level and below is in progress.

The orebody is a highly siliceous replacement in sheared igneous quartz porphyry, in which bands of chert are quite common. It is quite hard for drilling, breaks well in blasting, and stands up so well that it is possible to mine large bodies safely and economically without the necessity for timber or frequent pillars for support. The minerals occurring in the Bluff deposit include a predominance of pyrite, with a generous quantity of chalcopyrite, an irregular though noticeable sprinkling of zinc blende, and a small amount of galena. Some bornite and argentite have been found. Gold and silver values, as in the Jane, are irregular and spotted.

Fairview Mine—The Fairview deposit is entirely different from the Jane and Bluff in that the ore is in

veil-like masses, roughly parallel to the strike of the shear zone. The veins or lodes are twelve in number, varying in thickness from a few feet to 70 ft. and in length from 300 ft. to over 1,300 ft. The ground between the veins is a more or less mineralized green-mottled schist. The schist has been designated as "green-mottled" owing to the presence of "leaves" or chlorite.

Some of the veins outcrop at the surface; others have their upper limit underground. Most of the veins are traceable to some depth below surface, and three of them, the 1st, 3d, and 6th, are found, though not commercial, as far down as the 2,200 level, over 2,000 ft. below the outcrop. The dip and strike of the veins are approximately the same as the schistosity,—that is, 70 deg. to the south and S. 65 to 70 deg. E. respectively, while the rake or pitch of all orebodies is usually to the west.

Neither the ore nor the schist is very hard, although the ground stands well, requiring little or no timber in support of openings. There is no high degree of silicification, as in the Jane and Bluff mines. Basic dikes, mostly diorite, are at varying angles to the schistosity, which fact frequently interferes with stoping operations. These dikes are closely associated with the ore occurrence. The footwall of the Fairview deposit is the main band of slates, bounding the north side of the shear zone. The hanging wall of the veins is a well-defined schist, while the hanging wall of the deposit is a slate.

The chief minerals found in the Fairview are pyrite and chalcopyrite. There is a noticeable absence of any zinc or lead minerals. Near the surface, some secondary enrichment has taken place, resulting in the occurrence of bornite, chalcocite, and covellite. Very little gold and silver has been found. In non-metallics, gypsum, calcite, and quartz are most common.

Empress Mine—This deposit lies about 1,000 ft. easterly from the Fairview and on the west side of South Valley. It is entirely different from the Jane, Bluff, and Fairview deposits in that both the ore and inclosing walls are very soft, and there are really no distinct veins. Two lodes have been mined, although the ground between them is often sufficiently mineralized to be of commercial value. The general strike is S. 70 deg. E. and dip 65 to 70 deg. to the south, with a rake or pitch to the west. The 1,600 level is the lowest elevation (2,700 ft. above sea level) on which commercial ore has been developed, this being about 1,000 ft. below the outcrop.

The footwall of the Empress deposit is the main slate band, whereas the hanging wall is a "silver" schist, a name applied locally to the schist owing to its high degree of shearing. This condition has offered difficulties in mining and somewhat added to the expense. Leaching and consequent secondary enrichment are pronounced at considerable depth below the surface. The deposit is 500 ft. long and 150 ft. wide, with a minable depth of 1,000 ft.

The minerals found in the Empress deposit consist of the customary chalcopyrite and pyrite, with a variable quantity of chalcocite, generally found along fracture planes. Bornite has been noticed, as also occasional occurrences of native copper. Zinc blende is present to a small extent. Gold and silver values are of but little significance.

Victoria Mine—About 1,200 ft. easterly from the Empress mine the Victoria deposit has been developed.

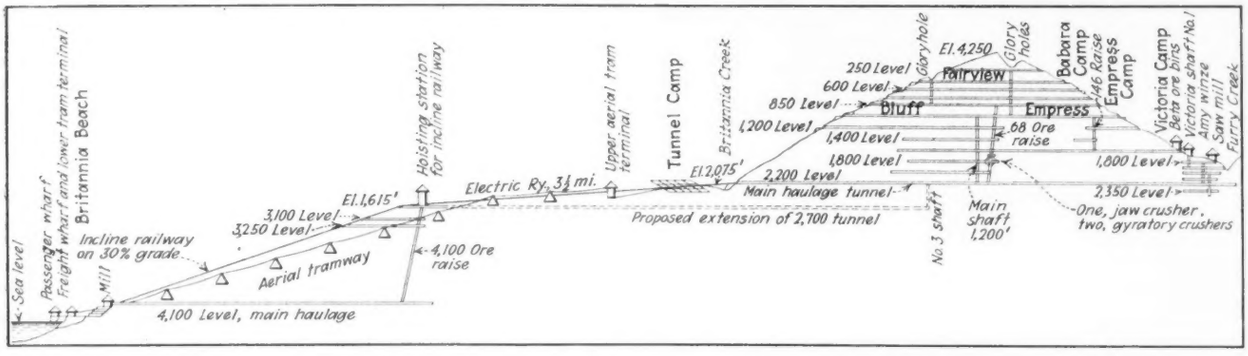


Fig. 2—Ideal section showing profile of transportation system

The ore lies in vein structure, similar to the Fairview deposit, but both the ore and surrounding rock are softer, requiring timber for support of openings, yet not as soft a formation as found in the Empress mine. The Victoria deposit does not come to the surface, but is covered with 100 to 150 ft. of glacial drift or hard pan. Pressures exerted by this overburden are important factors in mining.

The maximum length of the deposit is 800 ft., although no one vein has extended continuously over 550 ft., while in width 150 ft. would cover all veins. At present the known depth is 550 ft., although every indication points to a much greater depth than this. Nearly all the veins are roughly parallel, but in some cases the direction changes so that one or more merge, resulting in wide bodies of ore at these points. The separating rock is a green-mottled schist, with more or less mineralization. On the average, the dip is 75 deg. to the south and the strike is S. 65 to 70 deg. E.

The footwall of the deposit is a soft slate, corresponding to the slate footwall of the other mines. The hanging-wall is a green basic schist, changing quickly to a "silver" schist. Owing to the soft character of both walls, heavy timbering is necessary. Waste filling must necessarily follow ore extraction to insure continuity of operations.

The minerals occurring in the Victoria ores include chiefly pyrite and chalcopyrite, with very little zinc blende. Secondary enrichment is not pronounced. In the upper parts of the veins some bornite, chalcocite, and native copper have been found. Practically no gold occurs and only a very small amount of silver.

Shear Zone East—Though the shear zone has been traced for 2½ to 3 miles east of the Victoria, and considerable prospecting done thereon, no orebodies of any consequence have been discovered. Numerous "show-

Fig. 3—Mine camp with tunnel railway in foreground

ings" of pyrite have been found within this area, carrying small quantities of copper, and further prospecting with a diamond drill may disclose additional commercial ore deposits.

Mining Methods Many and Various

Methods of mining have been many and various since Britannia first became a shipper, and even today different methods are used according to the physical conditions surrounding the ground to be mined. With an abundance of timber adjacent to the Jane mine, it was natural that square sets were employed in the early stages of the operations. However, timbers are used, apparently, for the support of workmen, as there does not appear to have been any need for supporting the ground. Even today there are old square-set stopes in which the twenty-year old timber still stands alone, most of the blocking having rotted away. The square-set method was followed in the early days of the Fairview mine, two or three of the original stopes having been thus worked. About 1910, the shrinkage system was adopted for all mines then working, and that practice has been more or less generally followed, except in the Victoria mine. Where the orebodies outcrop at surface, open glory holes were employed, producing an average lower grade, which was offset by a lower unit cost.

The present mining methods employed are selected on the merits of each individual block of ground to be mined, the factors governing the selection being as follows: (A) Character and hardness of ground—that is, whether or not timber is necessary. (B) If timber is necessary, shape of stope to be carried — that is, whether rill or flat back. (C) Value of the ore, as to whether it can be mined at a profit under the method selected for it. (D) If waste filling is necessary, the sources for same and cost of filling per ton of ore mined.

To facilitate locating workings in the mines, the entire mine area has been divided into chute sections, 33⅓ ft. apart along the strike of the shear zone. Chute sections are numbered from west to east. All crosscuts, raises, chutes and winzes are given the number of the nearest chute section for designation, no matter on what level or vein they may be located. The various methods of mining in use are discussed and illustrated as follows:

Shrinkage Stoping—This method is used in the Bluff and Fairview mines, where the ground is suitable. After the orebody or vein is opened up by drifting, chutes are cut on the footwall side, each 33⅓ ft., and four-foot chutes built. The chutes are then connected one to the other, making a continuous opening along the ore for the length of the vein to be mined, 30 ft. above the level. Breast stoping is then carried on, using an end chute for manway and supplies. As ore is broken it takes up almost double its volume of space, and a little less than half is drawn out to provide room for men to carry on their work of breaking, further reducing the size of the ore. This operation is shown in section in Fig. 5. (See page 928.)

When ore has been mined to approximately one-half the level interval, 200 ft., a service raise is driven through to the level above. The lower end of the stope is then brought up and stoping continued to the upper level. In some cases a raise is driven on the ore between levels before stoping is undertaken, in which event the raise will serve as a manway as soon as stoping is under way.

Where the walls require it, a pillar is sometimes left in the stope for support. Stoping ceases about 20 ft. below the upper level, leaving pillars of this size for support of the upper level. The extraction of sill pillars above and below each level is done after the broken ore is drawn out of the stope above the level.

Modified Shrinkage—A modification of the above-described shrinkage system has been successfully tried in that no chute pillars are left in starting a stope. The drift is back-stoped to a height of 15 to 18 ft. and mucked out. Heavy stulls are placed from wall to wall on 6-ft. centers and supported by substantial posts. Round pole lagging, not less than 8 in. in diameter, is used to cover the sill sets. Chutes are built at regular

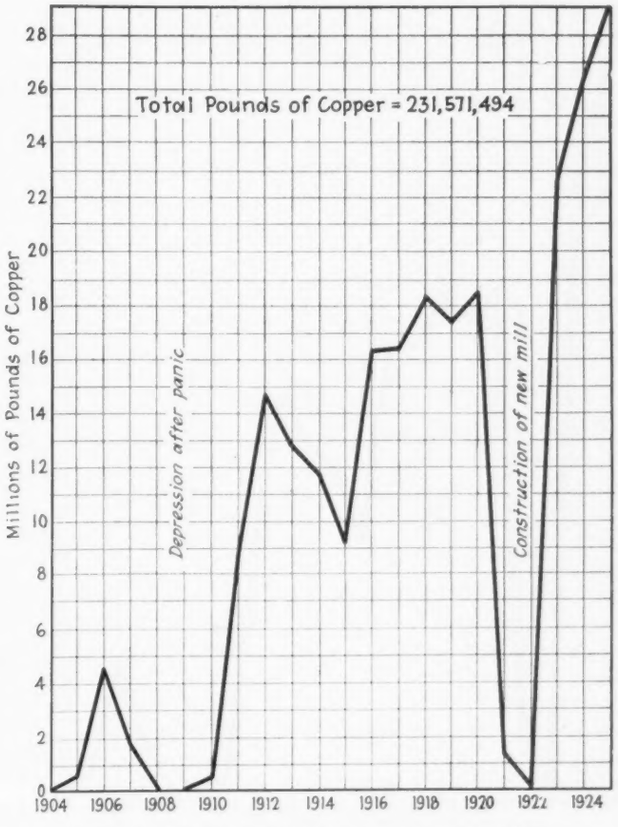


Fig. 4—Chart showing annual production from 1905 to 1925

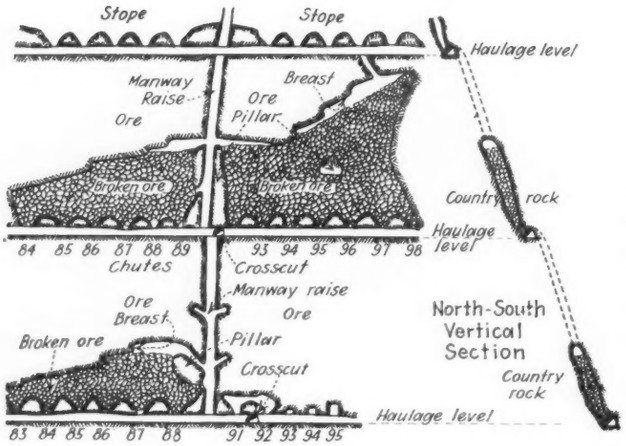


Fig. 5—Vertical section (west-east) of shrinkage stope in Fairview mine

33⅓-ft. intervals and regular back stoping is started. From this point the procedure is as described above. This method has the advantage of gaining at once half the ore formerly tied up in pillars, and the broken ore lying on the timber between chutes is easily recovered.

In the Bluff mine, where the orebodies are very wide, the shrinkage system is employed to good advantage, resulting in very low ore-breaking costs. Flat backs are carried, the over-break beyond the actual holes drilled frequently being 20 per cent or more. The ore is usually broken into large units, requiring secondary drilling and blasting. Present methods include drawing the broken ore from Bluff stopes through bulldozing chambers, where the secondary breaking is more efficiently done than up in the stopes. Production has greatly increased with the use of bulldozing chambers and ore-drawing costs have decreased. Fig. 6 illustrates this method of shrinkage stoping.

Glory Hole Mining—Where some of the orebodies extend to the surface, this method has been successfully used. Ore broken in glory holes is drawn through bulldozing chambers into transfer raises. Working benches are 3 ft. or more in width and of varying length. This method is the cheapest, but does not permit selectivity. Fig. 7 shows a typical section through a glory hole.

Rill Stoping—This method, adapted from Butte, is applied in both the Empress and Victoria mines, where the inclosing walls are too soft to permit much open ground. Fig. 8 shows a typical section through a stope in the Empress mine and represents an untimbered rill. A main raise is driven between levels, after which the drift is back-stoped and timbered. Inclined backs are started each side of the main raise, with a loading chute at the "toe" of each stope. The loading chute is moved as desired. Mining and waste-filling alternate on each side. Waste is supplied at the top of this main raise and diverted to either side as required. Rill plank or lagging is laid on the stoping waste pile to facilitate handling of ore and keep it separate from the waste. The untimbered rill is best adapted to veins of 10 ft. width or less, owing to difficulty of spreading waste filling and also to the fact that the ground makes it unsuitable for greater widths.

Timbered Rill—In the Victoria mine, square-set timbering has been advisable, because of the comparatively soft wall and ore, and also for the reason that abundant timber is available adjacent to the mine. Waste filling has proved a serious problem, as it is necessary to replace stoped ore with waste filling as quickly as possible.

In square-set stoping it has become advisable to carry the stopes in a rill shape. The drifts are back-stoped to a height of 15 ft. and cleaned out. Sill square sets with 8-ft. posts and framed 6 ft. centers are placed, with a regular stope set with 6 ft. 8 in. posts above the sill set. A raise set is then carried ahead in the center of the stope for about six sets above the sill. The raise set is then extended to the level above. No waste filling is required up to this point, but with the raise connection through, waste is then fed into the stope, taking the shape of the rill. Level intervals are 100 and 150 ft. and all ore is extracted as mined. Fig. 9 illustrates a typical timbered rill stope in the Victoria mine. Rill plank are spiked from cap to cap over the waste and removed when filling the stope. Six by ten timbers are used for all floors.

Besides the waste filling produced from development, waste is obtained from glory holes, where the gravel overburden is loosened and passed down through rock raises, to be distributed on the various levels. As mentioned in the preliminary discussion of the mines, there is from 100 to 150 ft. of gravel hardpan overlying the Victoria mine; hence the source of waste for filling is both cheap and abundant.

Underground Transportation

Ore transportation in Britannia mines, owing to the topography of the country, is essentially a gravity operation. More than 90 per cent of the ore mined is handled to the lowest haulage level simply by passing from one raise to another. Fifteen storage battery and five trolley locomotives handle the ore from transfer raises

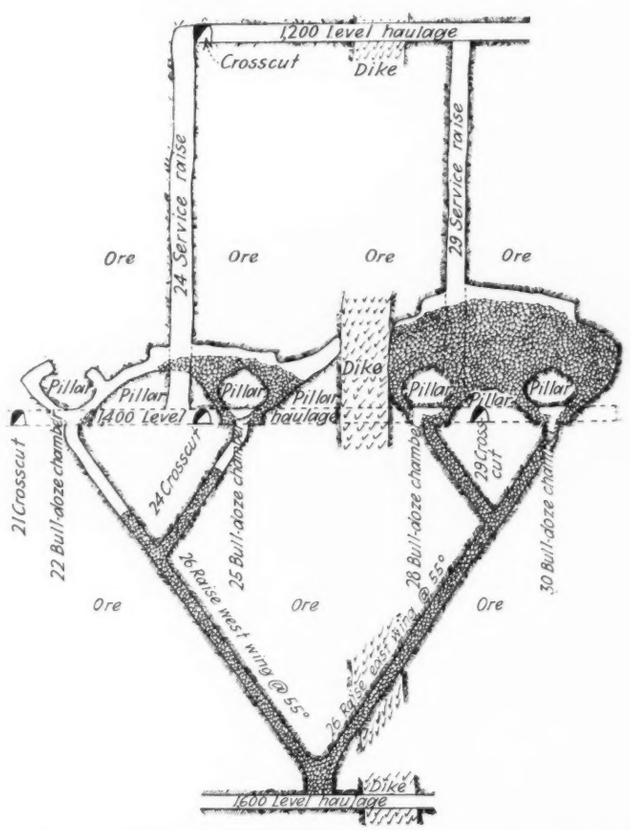


Fig. 6—Vertical section (west-east) through Bluff mine, showing modified shrinkage stope

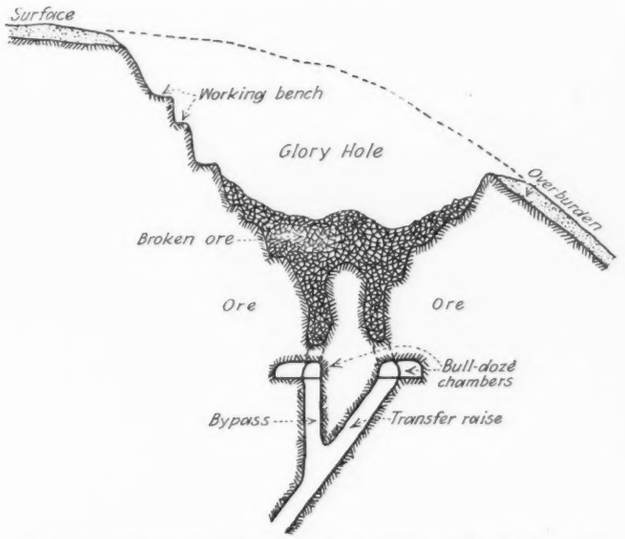


Fig. 7—Vertical section (west-east), Fairview mine, showing glory hole

to the main ore raise. Cars vary in capacity from one ton (hand trammed) to four tons.

Primary Crushing

Bluff, Fairview, and Empress ores are crushed in two stages, whereas the Victoria ore is crushed in one stage, to 2½ in. ring. In the former case, the first stage of crushing is done by a 24x36-in. Buchanan jaw crusher and in the second stage by either of two 7½ K Gates gyratory crushers. The Buchanan crusher is on the 1,700 level, alongside the main ore raise, the ore passing over a grizzly, through the crusher, reduced to 6 in. and back into the raise. The two Gates crushers are on the 1,800 level, one on each side of the main raise, so that either or both may be used to reduce the ore to 2½ in. ring. In the Victoria mine the ore is reduced from run-of-mine to 2½ in. ring by a No. 6 McCully gyratory crusher. Owing to the soft and friable character of the ore, only one stage of crushing is necessary. In August, 1926, the two 7½ K Gates crushers were moved to the mill at the beach, from which time the mine has delivered 6-in. ore, effecting material savings in the primary crushing costs.

The crushed ore is drawn from the main ore raises on the 2,200 level into 17-ton and 20-ton hopper-bottom railroad cars, nine to a train, and hauled by a 20-ton locomotive, over the one-half of 1 per cent tunnel grade to the yard. From here a 45-ton locomotive takes the train over the 3½ mile, 3 per cent grade, single switch-back railroad to the top of the 4,100 raise, 2,700 level. Here it is dumped and passed by gravity to the 4,100 level, which is on an elevation with the top of the mill. The ore is drawn from the 4,100 raise and hauled in 15-ton cars 4,000 ft. to the mill bins. The tunnel railroad equipment is flexible enough to handle economically 2,500 tons to 4,000 tons per day. The lowest unit costs result from the handling of the latter amount.

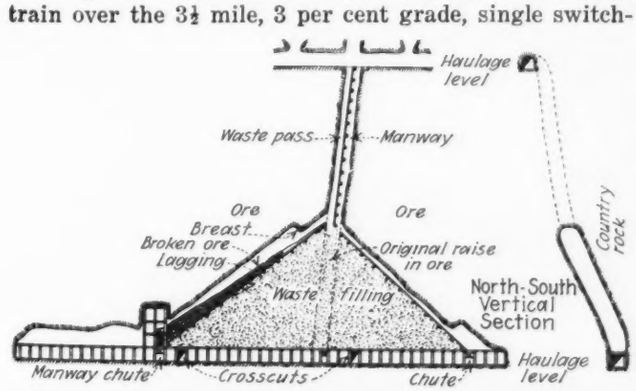


Fig. 8—Vertical section (west-east) through Empress mine, showing rill stope

Wages Increased by Bonus

Throughout all mines, where a man's performance can be measured he is put on a bonus system. The normal unit production or performance is set after due study and observations of the work are made for which a base wage is paid. The saving or decrease in cost per unit is split evenly between the man and the company. Thus, as the unit of performance increases, there is a reduction in unit costs. This system of bonus has functioned very satisfactorily.

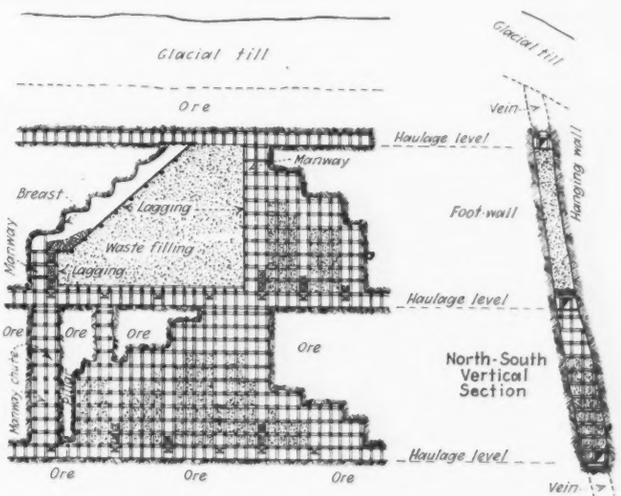


Fig. 9—Vertical section (west-east) through Victoria mine, showing rill and square-set stopes

Detailed mine costs are kept at all times, going hand in hand with the bonus records. These cost sheets are essential to the operation in showing the results of increased efficiency Furthermore, any improvement in operating conditions must show up in the unit cost, otherwise the expense incurred therewith is wasted.

Safety Council

A Mine Safety Council was organized in the fall of 1923, to further and promote "Safety First." Statistics covering the two and one-half years of existence show conclusively that the Safety Council has been instrumental in decreasing the number and severity of accidents. The council has as permanent members all mine officials, heads of departments, shift bosses, engineers, and the company doctor. Ten men are selected at random, two from each section of the mine and surface, to act with assistant foremen as an inspection committee for their section each two weeks. Written reports of inspection, containing safety suggestions, are submitted at the regular biweekly meeting of the council, and are read and discussed. Such suggestions as may be within the power of the committee chairmen to adopt are carried out forthwith. Other suggestions are discussed at the meeting, and if neither feasible nor practical are tabled with full explanations therefor. All accidents, whether first-aid or compensation cases,

are discussed at the biweekly meeting; suggestions for prevention or recurrence or reasons for occurrence, where possible, are offered. Altogether, the council has functioned well and is unquestionably a part of the operation to be fostered.

As is usual with mines that have been operating for a number of years, the drainage waters of the Fairview mine have become heavily charged with copper salts, and it has become profitable to treat these waters in a precipitating plant. The flow being treated averages 5,000 gal. per hour or more, containing from one to 1¼ grams of copper per liter. Detinned scrap has been found best as a precipitating medium, the consumption thereof being 1¼ lb. to one pound of cement copper recovered. The cement copper, assaying 80 per cent, is sacked for shipment. Improvements to the plant are planned, which will result in a greater recovery and higher grade of sludge.

Talc in Canada

Canada possesses one of the most important high-grade talc deposits in the world. This deposit, situated near Madoc, in Hastings County, Ont., has been, according to Dr. M. E. Wilson, of the Geological Survey, the principal source of talc for the manufacture of talcum powder in both Canada and United States for many years.

Talc occurs in several forms and is characterized by properties that render it useful for a great variety of purposes. The most valuable type is a white variety of sufficient purity to be used in toilet preparations. The principal deposit in the Madoc area is a crumpled mass of white flaky talc schist 1,300 ft. long and from 5 to 65 ft. wide, developed in dolomite not far from an intrusive mass of granite. Most of this deposit is owned by the George H. Gillespie Co., which operates a grinding plant at Madoc, the remainder belonging to the Asbestos Pulp Corporation. Total production of ground talc from the Madoc properties in 1925 was 13,678 tons, valued at $174,116. Formerly all that was not marketed in Canada was sold in the United States, but since the imposition of the Fordney tariff considerable amounts are being shipped to the United Kingdom, Germany, and other countries.

Gray talc schist, suitable for use in ground form as filler in paper, in dusting rubber, and for other purposes for which a pure white color is not essential, is found in the Eagle property, near Victoria, B. C.; near Anderson Lake, on the Pacific Great Eastern Railway; near Chaumox station, on the Canadian Pacific Railway; at numerous places in the eastern townships of Quebec, and at many other places in Canada. The talc schist deposits of the eastern townships of Quebec are associated with the same igneous intrusives as the asbestos deposits of the same region. They are similar to and lie in the same belt as the talc deposits or Vermont. Ground talc has been produced in a small way from the Eagle, the Anderson Lake, and Chaumox properties, in British Columbia, and plans are under consideration for erecting a talc grinding plant at Robertsonville, Que.

Deposits of the massive variety of talc called soapstone are known to occur near Banff, in Alberta; near Wabigoon, in western Ontario; and in several localities in the eastern townships of Quebec. Soapstone blocks for use in lining the roasting furnaces of paper mills using the sulphate process have been produced for several years from deposits near Robertsonville, Que.

Multiple-Hearth Roaster for Calcining Magnesite

The Spokane Plastic Magnesite Co. has recently built a calcining plant a short distance from the quarry of the Northwest Magnesite Co., Chewelah, Wash., in which the carefully controlled roast is carried out in a multiple-hearth roaster. The plant is described in the Nov. 27 issue of *Rock Products*. The carbon dioxide begins to leave the magnesite at about 1,000 deg. F., and with increasing rapidity until 1,400 deg. is reached; after that it begins to dead-burn, which makes a product that has no cementing properties.

The calciner in this new plant is a modified form of the Herreshoff roaster, designed by R. D. Pike, of San Francisco, and made by the Pacific Foundry Co. The furnace is 20 ft. high and 12 ft. in diameter, is lined with firebrick, and has seven hearths. Movable rabbles are provided on each hearth except the lower one, wherein the hearth moves and the rabbles are stationary. On this hearth the temperature is the highest, so the rabbles are made of a heat-resistant alloy known as "hibnickel" and are provided with a special cooling device. Oil is used for fuel, with burners on the lower two hearths; the air for atomization is supplied by a fan driven by a 10-hp. motor. A 5-hp. motor is used to drive the rabbles, though the actual consumption is only 3 hp., and a 10-hp. motor drives the fan used to force air through the rabble arms for cooling.

The crude magnesite as received has been dried and ground to pass a 10-mesh screen. There is much dusting in the calcining operation, so a Cottrell apparatus has been installed to recover this fine material. Cottrell equipment is also used by the Northwest Magnesite Co., which makes dead-burned magnesite in rotary kilns.

After calcining, the hot magnesite flows into a screw conveyor 45 ft. long, which serves as a cooler. It is then elevated and ground in a Raymond five-roller mill, of the high-sided type, so that practically the entire product will pass a 200-mesh screen. The discharge goes to a steel bin, lined with magnesite blocks.

Determination of Tin in Cassiterite

A. Pirlot, in a recent issue of a Belgian bulletin (Bull. Féd. Ind. Chim. Belg., 1926, 5, 281-284), describes a method for the determination of tin in cassiterite. The procedure, as abstracted in *British Chemical Abstracts*, is as follows:

The finely ground sample is digested with hydrochloric acid to remove iron, and the residue is collected, washed, dried, ignited and finally reduced to metal by heating for two hours at 740 deg. C., in a current of hydrogen. The loss in weight during the last-named treatment is a measure of the tin content of the ore. As a check the metal is dissolved in hydrochloric acid, the insoluble material separated, again reduced in hydrogen, and any further metal extracted as before, and the combined stannous chloride filtrates are neutralized with ammonia, oxidized with iodine, and boiled with sodium sulphate or ammonium nitrate. The precipitated metastannic acid is collected, washed with ammonium nitrate solution, and ignited to stannic oxide. For a good sample of cassiterite the tin content calculated from the loss on reduction agrees very closely with that obtained by weighing the tin oxide.

Prospecting by the Earth-Wave Travel Method

Another Geophysical Aid to the Geologist—The Theory and Its Application

By Karl L. Kithil
Consulting Mining Engineer, Denver, Colo.

NEW GEOPHYSICAL METHODS have been introduced as an adjunct to geology during the last few years for geological prospecting and determination of the earth's substructural conditions, especially where surface conditions completely or partly hide existing geological indications. Among these methods, which are of various kinds and are based on different theories, is one which is particularly interesting. It makes use of earth vibrations artificially created for the purpose.

In true seismology, pertaining to earthquake studies, certain instruments are used which give factors for the calculation of the distance and direction of the occurrence of an earthquake source, called the epicenter. In the geophysical work relating to substructure determinations, a study of the travel of the earth waves through the earth crust, at near distances, is of the utmost importance; and the speeds and velocities of the different earth waves in the media through which these waves are propagated must be determined, as well as their reflections in changing media. The factors so obtained form the basis for the required calculations for such field determinations as an adjunct to geology proper.

Waves May Be Artificially Created

Comparatively little is known of the intricacies of earth-wave travel, especially where such waves are a result of artificially caused disturbances. True seismology relating to the study of actual earthquakes has given us some interesting information, and a great deal can be learned from it. Some practical experiments along the lines of the study of earth-wave propagation through the ground, when based on artificially created disturbances, as by the explosion of dynamite, have shown that the wave propagation in such a case must be considered from a different angle than is the case with earth waves resulting from natural quakes, and which latter are usually measured and determined at great distances.

For a better understanding of the phenomenon, some of the more important points relating to this problem are given here. These data may be of guidance to those now entering this field of study. The data have been drawn from suitable literature as well as from the results obtained from practical experiments.

To the geologist, the phenomenon is interesting. If we study the earth waves as they travel along from stratum to stratum, with all their reflections and changes in velocity in transit, we may be led to the discovery of certain rock structures buried beneath the earth's surface and which, without the help of such waves, would not come to our knowledge.

Many Factors in Wave Travel Phenomena

As a source of light represents a disturbance which expands through the ether as luminous radiations; as sound spreads out its waves from a source in all directions, an earth disturbance likewise becomes the origin of seismic radiations through the material of the earth crust. They manifest themselves as elastic vibrations, causing, at points of emergence at the earth surface, slight movements and impulses. As rock masses are resistant and yield to stress and strain, they show these effects in the transmission of such disturbances through them. We have, therefore, to deal with factors of many kinds to understand the phenomenon of wave travel. As it depends upon density, elasticity, and compressibility or incompressibility as general properties of matter, this study is somewhat complex; but a considerable collection of data is available on these subjects which will be found helpful.

In the study of the propagation of earth waves through rock media, many things are shown which permit the acceptance of some of the speculations of the physicist so far as the transmission of disturbances in elastic matter is concerned. These investigations teach us much about the structure of the earth, at least so far as the outer crust is concerned, which is of especial interest to us.

Wave Travel Harmonic Motion

The phenomenon of earth-wave travel can best be described as a harmonic vibratory movement. This is the case in all solid, uniform, homogeneous materials through which we obtain a fairly uniform or harmonic motion of the propagated waves. The heterogeneous nature of the earth's crust from a geological point of view, however, is well known. The materials of the crust vary greatly in hardness, density, and elasticity, and, furthermore, they are interbedded, dislocated, and rearranged by earth forces and actions of the elements. All this causes changes in the vibratory movements and velocities of the transmitted waves. These waves are constantly hampered in their travel. A continual change in the original wave, in its motion and velocity, takes place, and these changes are almost proportional to the changes in the materials through which the waves have passed. The interpretation of this wave travel involves some complex problems, as not only velocity, frequency, and amplitude of motion, but also the time factors of arrival of the successive waves, have to be considered at the various points of observation.

Wave Transmission Through Solids Complex

Seismology, as an earthquake study, has taught us something about the complexities which enter into the phenomena of wave transmission through solid materials. These swinging earth movements can be determined in all their components. By measuring only one component at any given point it is possible to determine the relative vibratory movement at that particular point in one direction. To measure these components, pendulum weights, suitably suspended or arranged, are used. The relative movement of the pendulum mass—that is, the rotation or movement of it about its axis of support—will illustrate the relative movement of the ground and connected support to that of the pendulum mass itself.

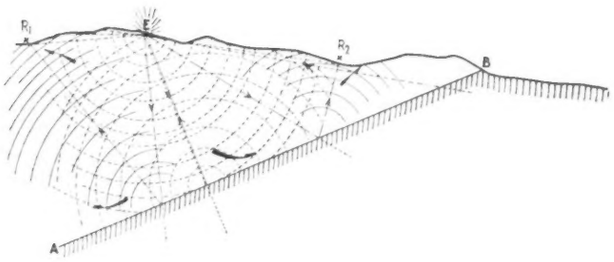


Fig. 1a—Schematic sketch showing wave motion of original and reflected waves. Curved arrows indicate sweeping motion along interfaces

Use is made thereby of the factor of moment of inertia, a relation of the movement of the axis of support of the pendulum to that of the instantaneous center of the pendulum mass.

These movements can be recorded by mechanical or optical means, the latter being preferable on account of the freedom of any frictional parts and because greater magnification of the actual movements of the ground can be obtained. The curves shown on a vibro-photogram of this nature indicate by the amplitudes of the swing of the pendulum the relative movements of the ground and pendulum support and that of the pendulum mass, and show the magnitude of the earth movement or vibration. Such a record also shows the period and frequency of the waves and gives the time factors of the arrival of the main wave and its resulting auxiliary vibrations.

Rock Characteristics Must Be Considered

Much can be learned from the travel of artificially created earth waves when measured and determined at several points varying in distance and direction from the central point where a disturbance was created. Aside from this study of records, the characteristics of existing known rock formations must be taken under consideration. Experiments along such lines thus require the consideration of unknown quantities in relation to known conditions.

Wave Speed Depends on Initial Force of Disturbance

Experiments made with artificially produced vibrations have shown that the velocity of wave travel increases with the force of the initial impulse. It would seem, therefore, that the rate of speed at which a shock is transmitted through the ground increases with the intensity of the initial explosion and manifests itself also as earth vibrations proportionally to the initial impulse. The speed of wave propagation is greater through solid rock than through loose ground, sand, or alluvium on account of the greater elasticity. Moisture content in rocks must be given consideration, as it affects their rigidity. Experiments have shown that

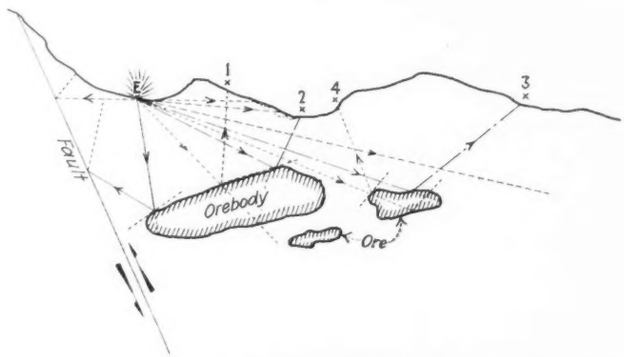


Fig. 1b—Sketch showing probable wave travel when encountering a buried orebody in fairly homogeneous ground

earth movements in dry sand are quite different from those in wet or water-soaked sand. We have, therefore, to study the various speeds of propagation of a disturbance through rock matter, the elasticity of the medium or substance as well as its density, and whether the material is dry or soaked with a fluid.

Something should be said here also about air-sound waves caused by the explosion of dynamite. These have often been mistaken for so-called surface earth waves. Air and sound waves, as such, are also recorded

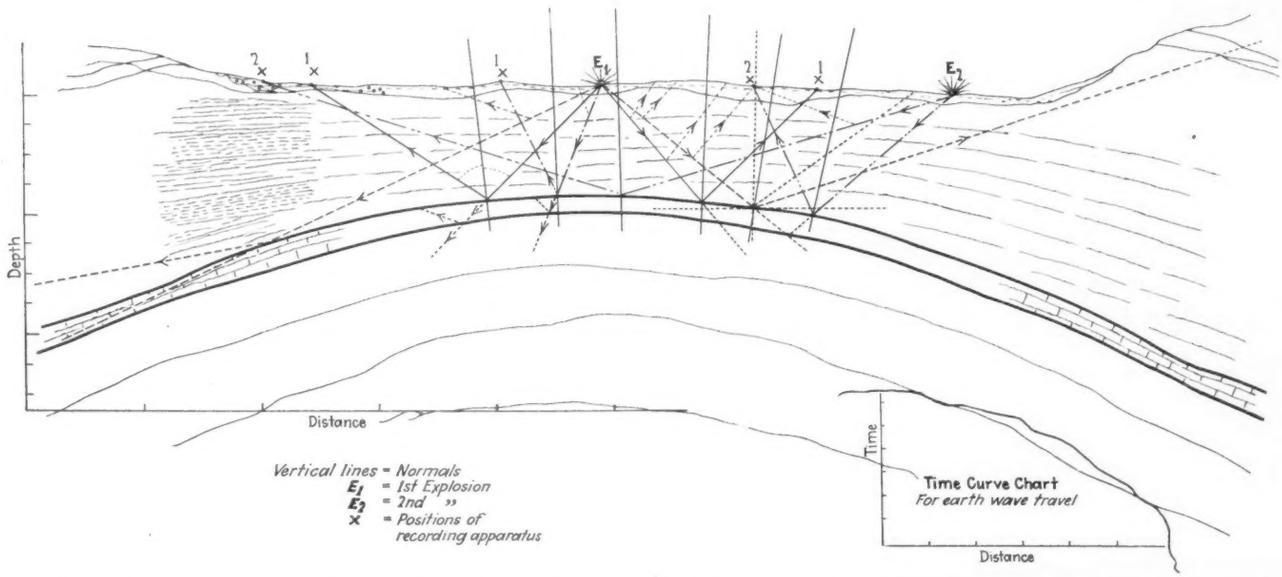


Fig. 2—Diagram showing possible earth-wave travel reflected at contact points. Ground consists of varying materials. E_1 represents first explosion; E_2, second explosion. X shows position of recording apparatus

on the instruments where explosives were fired at the surface of the earth; these are distinct from those earth movements and earth vibrations which are due solely to earth waves. Air and sound waves are, in such a case, created simultaneously with the earth disturbance and consequent earth waves, but are propagated much more slowly than earth waves. It is important, in making tests of the effects of earth waves, to employ for each test the same amount and strength of explosives under similar conditions, if reliable results for comparing one area with another are desired.

Take as an illustration a surface boundary between two masses (see Fig. 1, line *AB*), and assume that the two masses are of different density and elasticity, and that an elastic wave passes through so that it strikes the interface of the contact of the two masses squarely, actuating every point of the interface. A wave is started in the other medium and passes on at a different speed. A reflected wave is, at the same time, sent back into the first medium. Most of the rays of the wave of the disturbance fall obliquely on the surface, and it is obvious that the propagation of the original wave effects different parts of the interface at different times. The sweeping effect along the interface gives thereby impacts at successive points at the interface at a different instance of time at each point. At each point, then, as it is disturbed successively, waves are passed on into the second medium and also back into the first medium, as reflected waves. This phenomenon may explain some of the irregularities in the recorded waves on some of the photograms, which often were difficult to interpret, and were at times confusing.

In stratified formations, where the media are two or more elastic solids, complexities often arise on account of the resulting different waves. In such cases the wave motion and its recorded data may become so complicated that a suitable interpretation may not be possible, at least not at this time and not without further careful experimentation.

The main points to consider in work of this sort to determine unknown substructural conditions of the outer and upper earth crust are the transition of an elastic wave from one medium into another, its reflection, and the character of the resulting wave motion from there on.

Waves Reflected by Faults

Large dislocations or faults are barriers to the propagation of seismic waves and have a great influence in the reflection of them, modifying the reflection and the transmission across the boundary whenever the angle of incidence is changed. The earth surface is also a barrier; only a small fraction of the original wave energy is being transmitted into the air, and consequently any elastic wave which reaches the surface internally must be again reflected within the crust and is again transmitted by successively internal reflections against the surface boundary. This may, to some extent, explain the appearance on records of so-called extraneous waves which show up on records of large magnifications. With continued study and experimentation and practice in the field, many of these complexities of wave motion, as they appear, will be in time more thoroughly understood, so that a better comprehension and final interpretation of the records will be possible.

Nearly all seismic record photograms show up some irregularities, caused by auxiliary vibrations and tremors, which, however, can be recognized and which have to be eliminated so far as their interference in the interpretation of the records is concerned. In general, it is possible, however, to obtain from such field work a record of data regarding the composition of the hidden structural conditions, which may, in time, yield results beneficial to the geologist in his work within unknown areas of ground.

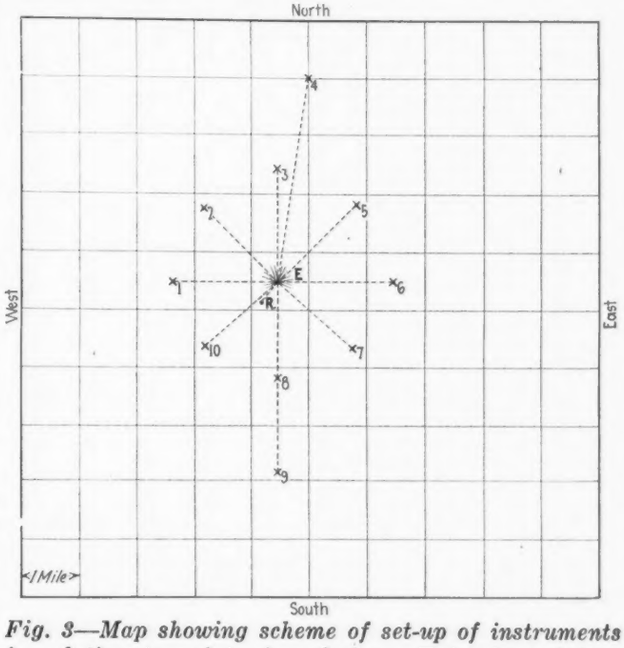


Fig. 3—Map showing scheme of set-up of instruments in relation to point of explosion. E is the point of explosion. X, X_1, X_2, X_3 and so on show the position of the instruments. R is the radio sending station

Field Instruments Should Be Portable

Many suitable seismic instruments for earthquake measurements have been invented and constructed which give clear records for the determination of location, origin, and direction of the quake so recorded and which also give factors for the calculation of the forces enacted upon the ground by such earthquake waves. These older earthquake instruments in general are, however, not suitable for any practical field work for the determination of substructural conditions in territory where such measurements have to be made. To accomplish this, the instrument must be, first of all, portable without sacrificing by its portability any loss in sensitivity. Furthermore, the records should be taken photographically to permit a maximum magnification of the relative movements of the sensitive pendulum. Various instruments of this kind have been devised and are in use today.

Without going further into the construction of these portable instruments, reference should be made to some records which were obtained from the resulting photograms. Examining such a record, one can see from its configurations what changes of motion of the propagated waves took place at the point where the instrument was installed. If we place several of such instruments in varying directions and at varying distances from the point or source of the disturbance, as shown in the diagrammatic sketch (Fig. 3), we obtain records which show up the wave travel in all these directions and over all the distances caused by a common disturbance. If, then, at intervening points, a

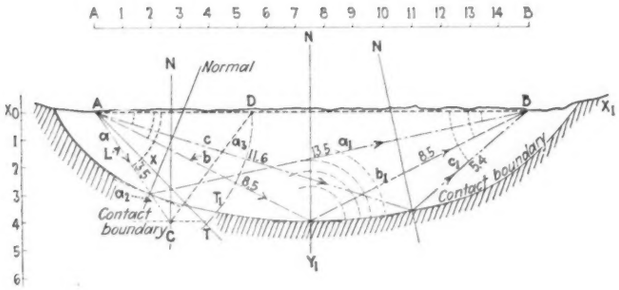


Fig. 4—Diagrammatic sketch showing cross-section of basin-like curve indicating a wave-reflecting medium

change takes place which is conducive of any changes in the wave travel, the resulting photodiagrams should reveal this, and a comparison of each of these records permits interpretation and mapping of the results. We cannot expect in most cases, except perhaps in stratified formation, much of a synchronous harmonic motion; records will frequently indicate a complex motion caused by the successive pushing of the waves in its vibratory propagation through changing media. The wave travel is constantly resisted, with the result of a compressional condition, expanding again as it passes from denser to more elastic media into other media of less dense and less elastic qualities and undergoing thereby changes in velocity, amplitude, wave length, and, consequently, and also in its relative acceleration. Further influences for such changes in the wave motion of this kind are also a result of reflection and refraction of the waves when passing from one medium into another. While we have to deal with a multitude of complexities which enter into the entire phenomenon, we have, fortunately, means of interpreting some of the records which clearly portray this wonderful action and reaction.

In general, the symbols contained on such a record are, in spite of their apparent complexities, not much different from those impressions we see on a phonographic record when viewed in a high power microscope; nor are they more difficult than other hieroglyphics or symbolic imprints which we have all learned to interpret. Here nature gives us the foundation for a record inscribed free from any personal influence or impulse of the operator, acting solely on its own account and by its own forces, changing its characters as they are formed through the influence of natural laws, but aided, for registration purposes, by delicate mechanical and optical devices, transmitting these impulses in all their phases, without interference, on to a lasting and interpretable record.

Procedure in the Field

Based on these theories and knowledge, methods have been developed whereby explosions at or near the surface create artificial disturbances within an area to be geologized. Highly sensitive, portable instruments of the seismo-vibrographic type are installed on the ground to be tested. Careful timing arrangements are necessary. Stop watches can be employed for timing purposes; or, better still, timing arrangements can be incorporated in the driving mechanism of the photo device; or externally by intercepting the reflected recording light ray at certain fixed intervals. To complete such an operation, to save considerable time, and to obtain very accurate records of the area to be tested, a number of such instruments are placed at distances miles apart from the source of the disturbance to be created and in varying directions from it, simultaneously effecting the discharge of all instruments from one central point by suitable radio relays, which, as single receiver sets, are attached to each recording instrument, cause the necessary contacts to be made, and thereby set the machine in operation and light the lamp needed for the reflection of a ray of light for the taking of the photograms. Immediately after that, the charge of dynamite is exploded by known means. The instruments should be provided with an arrangement whereby after a certain time interval all instruments come to a stop. Thereafter, one man travels from one instrument to the other to remove the exposed records, develop them, and mark them for identification.

This is by far the most convenient way of handling the matter, avoids the employment of a great number of men in the field, does away with the stringing of wire connections over the ground, and saves considerable time and expense. Of course, in some cases, the employment of one or two instruments may be sufficient, but in such a case the repetition of the blasting of dynamite, after setting up of the instruments at new positions, cannot be avoided.

What Is the Speed of Earth Waves?

When reviewing what is known about velocities of earth waves, from observations made, one will have to differentiate between time factors obtained from actual earthquake measurements at great distances and those obtained from practical experiments made by causing artificial disturbances by means of explosions or other artificial causes. In the case of artificial disturbances, not all data are often contained in the reports as to quantity and strength of dynamite employed and under what conditions these explosives were discharged.

Earth waves resulting from artificial disturbances, such as the explosion of dynamite, show both normal or condensational waves and also transverse waves. The speed of such earth waves through solid media depends greatly upon the intensity of the initial shock and also upon the density and elasticity of the material through which they are propagated. Their velocities seem to range from one to four kilometers per second of time. As an earth wave passes from one medium to another, reflection and refraction take place, changing thereby the original wave form and velocity according to the change in the medium at boundaries within the media. From it can be seen that it is possible to determine points within the earth crust where such changes take place, as well as the possible location and depth of such an occurrence.

Speeds of waves have to be determined in varying ground, and much work has yet to be done to collect and correlate the data obtained by various investigators with respect to the conditions under which the tests were made and the methods and instruments employed.

The Theory Demonstrated

In the diagrammatic sketch in Fig. 4, points *A* and *B* are marked as imaginary points of epicenter and points of observation respectively. The distances are marked to indicate a scale that can be suitably interpreted. The depth is likewise divided to scale.

If a wave is sent out from point *A*, its rays travel in all directions. For the sake of convenience, a cross-

section of a basin-curve was selected indicating a wave reflecting medium. From it can be seen that the three selected rays, *a*, *b*, and *c* of the wave and their reflected rays a_1, b_1, and c_1, respectively follow an entirely different path of travel to reach point *B;* but it also shows that the length of the path of each ray is the same in either case. On the other hand, if we consider the path of the ray a_2 and that of the reflected ray a_3, letting it strike a horizontal interface at point *C*, instead of an inclined interface as is the case with ray *a*, we can readily see the change in the angle of reflection and the consequent different course which the reflected ray follows, merging at the surface at point *D*.

Considering now the earth-wave travel and assuming thereby that the *a* ray of the wave follows along the surface and is propagated at a rate of speed of 2 km. per second of time, and that the condensational or longitudinal wave through the earth media travels at a rate of 4 km. per second of time, we find in that case that the reflected longitudinal wave must arrive in either case of the wave travel prior to the arrival of the surface wave at points *B* or *D*.

In one case the differential or relative arrival of the wave at points of observation, as for instance at *D*, is as follows: Ray *a* and reflected ray a-a_2-a_3 arrive at point *D* within a time interval of 2.4 seconds, whereas the surface wave arrives at the same point at an interval of 2.75 seconds, taking the intervals from the time of creation of the disturbance and that of the respective arrivals of these waves at the point of observation. In that case the distance between the point of disturbance and that of point *D* is 55 on the scale, or call it 5.5 km. That is also approximately the distance of path of travel of the surface wave. The path which the longitudinal wave a_2-a_3 followed indicates a path of a length of 96, or call it 9.6 km. The time factor of arrival was 2.4 seconds for the wave following the path a_2-a_3 from *A* to *D*. If the speed of propagation of the wave is assumed to be 4 km. per second of time, then the length of its path through space within a straight line distance can be calculated by multiplying the time factor of arrival with the known factor of wave travel for this kind of wave—namely: 2.4 x 4, giving a result of 9.6 km. Knowing the distance between points *A* and *D*, which are voluntarily selected points, the probable depth to the point of reflection of the wave can be calculated.

Now, taking up the wave path a-a_1, between points *A* and *B*, we find that the selected distance is 150, say 15 km. The surface wave at a rate of speed of 2 km. will show a time interval of arrival, from the time of start of the disturbance, of 7.5 seconds of time. The arrival of the longitudinal wave a-a_1, if reflected at the point indicated in the sketch, and striking the interface at that point at an angle of incidence, as shown, will be reflected and travel along the path a_1 to point *B*. The time required for the arrival of the wave, assuming a speed of propagation of 4 km. per second of time, is, therefore, 4.25 seconds. It arrives consequently before the surface wave reaches point *B*. The differential between these time factors gives us the factor for the length of the path traveled through space within the ground and which, in this case, is for the longitudinal wave, about 16.9 km. This shows that if such a condition, or a similar one, exists, as, for instance, a basin with slanting sides and round bottom or base, the angle of incidence for the reflection of the onrushing waves must be different at almost each different point of incidence. The three rays, *a*, *b*, and c, selected for this illustration, would arrive simultaneously at point *B*, requiring the same length of time of travel and covering the same length of path within its respective space through the earth material within that distance, although being reflected at entirely different points and striking the interface or boundary of changing materials at different times. Such an ideal condition, of course, rarely exists in nature; but the illustration will help in the comprehension of the phenomena and its intricacies. As, however, instruments for testing unknown ground for its substructural conditions are set up at varying distances and in varying directions, even the existence of such an ideal basin can be revealed by such a method and its extent and depth can be approximated thereby. Where it is desirable to determine the existence of a line of division of interbedded media of different density and elasticity—that is, the existence of a suitable structural target beneath the surface of the earth waves—it can be seen from the foregoing description that this can be accomplished.

The exact determination of the various time factors of rate of propagation of earth waves through different kinds of earth media will yet require much experimental study. If we take the above assumed time factors of relative propagation of the so-called surface wave and that of the longitudinal wave, as 2 km. and 4 km. per second of time respectively, we obtain a relative ratio of velocity factors of 1:2 approximately.

Interpreting a Seismic Photo Record

Further information is given here in the example of an ideal condition showing how a determination from such a seismic photo record, when properly recorded, can be obtained. The establishment of suitable formulas is left to the skilled mathematician; they can be established the same as has been done for true earthquake seismology.

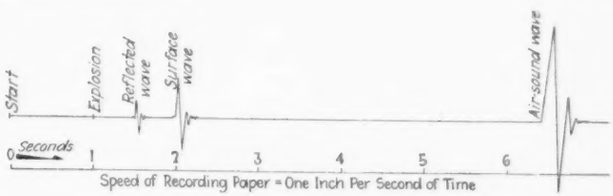


Fig. 5—Impulse record

If the photogram of the seismic instrument records two or more successive impulses, when measured on ground between known distances, such measurements will give primary information with regard to the possibility for the utility of application of the method on such ground, and it can then be seismologically, or otherwise geophysically, geologized. Assuming that, for such test purposes, only one horizontal pendulum instrument is installed in a direction at right angles to the wave travel from the point of disturbance, then the movement of the earth crust at that point and its related vibrations can be measured. If desirable, the transverse waves emanating from the same source of disturbance and their arrival at points of observation can be determined by placing another horizontal pendulum instrument at right angle to the other.

As indicated in the diagram (Fig. 6), assuming *AB* to be a distance of 2 km. between points of disturbance and points where the instrument is set up for measure-

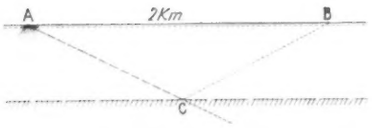


Fig. 6

ment; and assuming, further, that we obtained a record showing, as its first impulse on the photo-seismogram, a motion which indicates a time interval of 0.54 seconds between the moment of the disturbance and the arrival of the wave at point of observation; and another recorded motion at a time interval of one second, or 0.46 seconds later than the first impulse recorded; then, knowing the distance between these two points, and also knowing the time speed or velocity factor for the surface wave, a calculation is possible of the approximate wave path of the longitudinal wave to the reflective medium through the ground space below the surface which, in a case of longitudinal wave travel of 4 km. per second, would indicate a depth of 500 meters to the reflective medium, or a wave path of a length of about 2.19 km. through this space in the ground.

Time Factor Will Determine Existence of a Key Structure

The time factor for the surface wave can be determined beforehand in any new field. Such a test will, at least, determine the existence of a suitable key structure or target formation within the area which determines whether further promising and more detailed geophysical prospecting is advisable.

Using, as a basis for calculation, the assumed time factors above indicated, we obtain the following results: That the longitudinal wave, or its rays, were reflected at some point beneath the surface of the ground, as, otherwise, these rays would have passed on through the earth, emerging at some far distant point at the surface or dying out altogether before they would reach the surface at such points. It indicates, also, that at that rate of speed the longitudinal wave, or its resultant rays, traveled between the two surface points under consideration, over a path equivalent to a length of 2.19 km. (4×0.547).

The distance being known, it results in a time factor which will make it possible to determine or calculate the probable depth of the occurrence and position of changing and reflecting boundary media. The deviation from a straight path over the known distance can be calculated with more or less accuracy by applying geometrical mathematics, and thereby the approximate depth of the occurrence can be indicated, even assuming that the rays do not follow a decidedly straight line and following a slightly curved path within the earth ground.

The transverse waves are, no doubt, the result of the propagation of wave motion itself as it passes on through solids. This can be recorded and shows the arrival at different times from the other recorded waves, which may be due to differences in their speed of propagation. It is assumed that these transverse waves have a velocity of about 2.5 km. per second of time.

Looking at the chart, Fig. 4, we can see that a transverse wave, which must be the result of the forward pushing of the longitudinal wavefront within solid media, would not reach, for instance, point *D*, except as a result of the ray of a wave issued at a probable point *T*, and which reaches point *D* as a measurable transverse ray T_1 at point *D*, or thereabouts. As the transverse wave appears to be a side ray starting at any points along the travel of the longitudinal wave, its time factor as a combined wave should be calculated from the point of issue as a transverse wave; that is, from point *T* over T_1 to *D*. The total speed, therefore, of such a transverse wave or ray is a combination of ray *X* ($A=T$) (or any other longitudinal wave) calculated at the rate of propagation of 4 km. per second of time; and, from there on over path $T = T_1$, at another rate which must be slower than the original speed of the longitudinal wave. Considering such a combination of time factors of propagation for the main and transverse wave, the latter being a resultant, we obtain, in this case, a length through space between two fixed points of 56 (say 5.6 km.) and an approximate path of the transverse wave as such, of about 45 (say 4.5 km.). Figuring the speed of the first wave to point *T* at 4 km. per second of time, we obtain a time factor of 1.4 seconds of travel and 1.4 seconds for the travel of the transverse wave over the path from point *T* over T_1 to *D*. This would be a total of 2.8 seconds. Consequently, this transverse wave arrives at point *D* .4 seconds later than the longitudinal wave and about .05 seconds later than the surface wave.

Discussion Assumes Ideal Conditions

This discussion represents more or less normal or ideal conditions, and very little can be predicted, at this time, as to how the method will work out in practice or what time factors are obtained in less homogeneous and greatly varying ground.

Further research and practical work in the field should prove of benefit to those interested in this branch of technical science and should reveal further interesting data. In general, the entire phenomenon can be looked upon with some enthusiasm as to future results and possibilities, when the investigations are conducted in strict accord with scientific requirements and accuracy.

So far, it appears that the relative movements of the pendulums in sensitive and well-synchronized instruments of this nature must, by their impressions made upon the records, indicate some valuable data, which, in time, will become more easily interpreted as to some of the conditions existing within the interior of the outer earth crust in those strata that are to be found comparatively near its surface.

South Africa Mining Fluorspar

Fluorspar is being mined on a rapidly increasing scale at two localities—viz., at Ottoshoop, near Zeerust, in the Marico district, and at Mabula, near Warmbaths, in the Waterberg district of the Transvaal, the production at the former place being at present about 10,000 long tons per year, and at the latter about 1,600 tons. Each deposit contains high-grade material, which is of 99.5 per cent purity, with a silica content of less than 0.3 per cent, and so is especially suitable for the manufacture of hydrofluoric acid.

The remarkable purity of the mineral has already attracted attention abroad, and an important and growing export trade has been developed in the last few years. With the recent establishment of an iron and steel industry in the Union, the internal demands for fluorspar are likely to increase considerably.

A Glimpse of India's Mica Industry

Labor Plentiful but Unsatisfactory—Machinery Unpopular—Raw Material Found in Many Parts

By George Cecil
Paris, France

ALTHOUGH mica abounds in many parts of India, few persons make a fortune out of it. The local as well as the export demand always has been extremely brisk; native labor is plentiful and inexpensive, there being a dozen applicants for each vacancy. Yet the white manager of the works (whose income partly depends upon commission) and the European firm employing him rarely amass the hoped-for number of *rupees*. And this is easily explained.

The mining is carried out under such primitive and wasteful conditions that, cheap though labor is, an unnecessarily large number of workers are required to get through comparatively little work. Quantities of mica, for example, are damaged every day, and all has to be hauled to the surface, and by man-power, machinery being unknown. Even when it has been introduced, the native workers, resenting any contrivance which does away with manual labor, take an early opportunity of doing mischief to the engine. The black oiler purposely omits to replenish the oil cups, or he artfully mixes dirt with the lubricant; heated bearings and an enforced stoppage are the result. The sight-feed lubricator is not filled, and then cylinder trouble results. Anything to get rid of the obnoxious innovation. The Indian native believes in enforcing what he calls his rights!

Periodical holidays also interfere with the output, there being about fifty of them a year. These, added to the fifty-two Sunday holidays instituted by the white manager, as well as sundry others, reduce the number of working days considerably. Whether the mine is owned by Europeans or natives, holiday conditions are the same. The laborers further handicap their much-tried employer by frequently demanding leave of absence on the grounds that they are sick—even unto death. None dream of producing a doctor's certificate, but should the boon not be granted, every native in the mine promptly goes on strike. Further loss of time is the result.

Sometimes the native workers are persuaded that a ghost haunts the place; absence from work is the result. Not till the manager has paid a certain sum to the priests, who then undertake to exorcise the malignant spirit, will the natives return to duty. Great is their dread of the *bhut*.

Damage by Earthquake

Indian mica compares favorably with that in other lands. It is elastic and tough, and if earthquakes and landslips (which are forever occurring in "the rains") crack the sheets, thus greatly lowering their value, they mostly can be turned to good account. "Books" of yellow and brown mica averaging from 10 to 15 ft. across often are found, and they are wholly free of flaws. Those, however, which exhibit many cracks are put to use, there being a strong demand for powdered mica over almost all of India. Frequently it is used as a machinery lubricant and for the purpose of frosting the better class of toys; when ground very fine, "educated" natives rub the powder on their chins after shaving, the ladies of the *hareem* also fancying it. Powdered mica is exported too, and in considerable quantities, particularly for use in distant *hareems*.

Sheet mica, specially prepared and known locally as *tälg*, is largely used by the native painters, its exceptionally smooth surface greatly appealing to them. Windows for lanterns, the peep-holes of furnaces, and lamp chimneys often are made of mica in those districts where glass is scarce and expensive, while machinery users everywhere in India find it handy for boiler and steam-pipe packing and as insulators for electrical purposes. A ready sale awaits all that is taken out of the mine.

An Unfortunate Experiment

Two years ago an English globe-trotting capitalist, when in Calcutta, went into the mica question. Taken "up-country" to a mine, he was shown how the mica is laboriously hauled to the surface, the cutting process, and the crushing operations. Having drunk his fill of knowledge, the opulent tourist, scoffing at all that he had seen, returned to Calcutta and negotiated with the proprietor for the purchase of the mine. "I intend," quoth he, "to put in a smart manager from England, who, acting under my orders, will run the concern in an intelligent manner. Name your figure." The astute owner, recognizing that a fool quickly parts company with his money, demanded more *rupees* than he had, in his wildest dreams, ever hoped to possess. The sum was paid over without a murmur.

Six months later the mine was put up to auction, fetching but a fraction of the price which had been paid for it. The imported manager, loath to abide by local conditions, ignoring the fact that in the "unchanging East" natives decline to work if one refuses to humor their prejudices, had rubbed up everybody the wrong way. Three months after his taking charge, the output was so limited, owing to the exasperated miners having "downed tools" every few days, that the angry proprietor dismissed the "smart" manager by cablegram. The last named individual, however, suffered little pecuniary loss, for he brought an action against his employer and proved breach of contract. A sympathetic judge awarded him the balance of five years' salary. But the mica business in India no longer provides so useless a man with a living. All who understand local conditions fight shy of him.

$8,000,000 Capital in Canadian Petroleum

Capital employed in the crude-petroleum industry in Canada in 1925 totaled $7,954,722. Salaried employees and wage earners to the number of 259 were employed in this industry; the earnings of these employees were $318,101. Fuel and electricity costs were reported at $20,990. Power employed consisted of ninety-three units, with a manufacturer's rating of 1,803 hp.

Principal Statistics of the Crude-Petroleum Industry in Canada, 1924 and 1925

		1924	1925
Number of plants		119	180
Capital employed		$5,650,086	$7,954,722
Number of employees	On salary	29	25
	On wages	129	234
	Total	158	259
Salaries and wages	Salaries	$24,236	$33,722
	Wages	128,721	284,379
	Total	152,957	318,101
Cost of fuel and electricity		18,656	20,990
Selling value of products		467,400	1,250,705

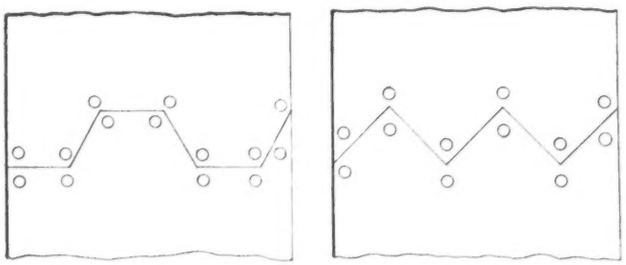
Useful Operating Ideas

Lagging a Slippery Pulley

By Charles Labbe
Clarkdale, Ariz.

Slow-speed cast-iron pulleys subject to work of a heavy nature are often found to be slipping too much for the load intended. At times the belt will slip off, or at least to one side, diminishing the belt bearing surface and aggravating the trouble. The lining or lagging of the pulley by means of a piece of rubber belting which covers the entire rim is better than an excess of belt dressing.

The best practice is assured by fitting the ends of



Alternative methods for jointing rubber belt pulley lagging

the lining along a zigzag line as indicated in the accompanying illustration. A straight line joint will cause one end to roll back a trifle under the strain and make a ridge across the pulley rim, which is not wanted. To prevent the buckling up of the lining and to have a snug fit, elevator bolts must be placed every 6 or 8 in. in every direction.

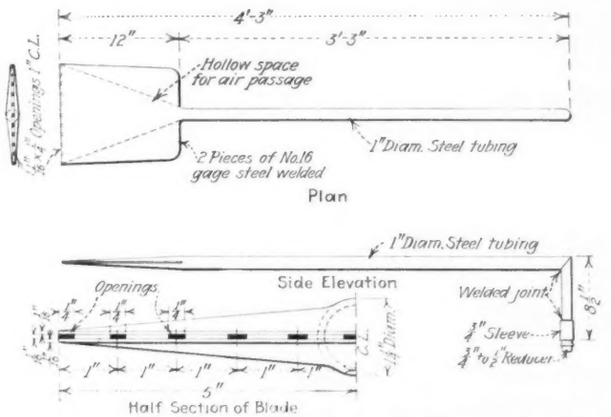
Compressed-Air Shovel

By J. Owen Ambler
Smelter Superintendent, Phelps Dodge Corporation, Clifton, Ariz.

A compressed-air shovel, devised by T. A. O'Neil, foreman in the preparation department at the Clifton smelter of the Phelps Dodge Corporation, has proved especially suitable for unloading concentrates. The concentrates are received from No. 6 concentrator at Morenci in inverted V-bottom cars equipped with side doors. The construction of the shovel is shown in the accompanying drawing.

By use of these shovels the size of the unloading crew has been cut to half, or less, of that formerly used and the unloading operation much expedited. In a test one man using the compressed-air shovel, with air at about 75-lb. pressure, unloaded and thoroughly cleaned a car containing forty-five wet tons of concentrate in seven minutes, including one spotting of the car.

Under regular routine operating conditions where two men unload a string of from six to ten cars of concentrate, the time for the two men averages ten minutes per car, exclusive of spotting, making the labor cost for unloading, including thorough cleaning of the car, about



Plan, section, and design details of compressed-air shovel

one-third of a cent per wet ton. The concentrate handled here is about 60 per cent flotation and 40 per cent sand, and contains 9 to 11 per cent moisture and 22 per cent copper. On account of its high copper content particular attention is paid to thorough cleaning of the cars, to prevent loss in transit when they are returned to the concentrator.

Electrical Timing Device for Ore Samplers

At the Garfield mills of the Utah Copper Co. an electrical timing device, designed by the engineering staff and made in the shops of the company, is in use for the operation of all of the motor-driven samplers in each mill. All of the samplers cut their respective ore streams simultaneously and at regular intervals. This is effected by the master timing device shown in Fig. 1 on page 939.

The device is continuously driven by a $\frac{1}{8}$-hp. motor operating at 1,200 r.p.m. The motor revolutions are reduced by two worm-gear drives in series. On the shaft of the second worm gear is a small crank which operates a pawl engaging in a toothed wheel. Each revolution of the crank advances the toothed wheel an angular distance equal to the space of one tooth. The shaft of the toothed wheel carries upon its extremity a pair of electrical make-and-break contacts at opposite points. These are inclosed in a case provided with a glass front. In each revolution there are two contact intervals of a definite time length. The electrical current operates the motors, driving each sample cutter through relays which open and close the motor circuits automatically.

Each sample cutter is operated by 2-hp. induction motor, shown in Fig. 2, which drives a worm gear, a pinion on the shaft operating a toothed rack on rollers, to the end of which is attached the bucket arm of the sampler. The length of the rack is proportioned to the width of stream to be cut. A reversing switch returns the rack to its original position after making its outward and inward cut of the pulp stream. The rig is compact and operates satisfactorily.

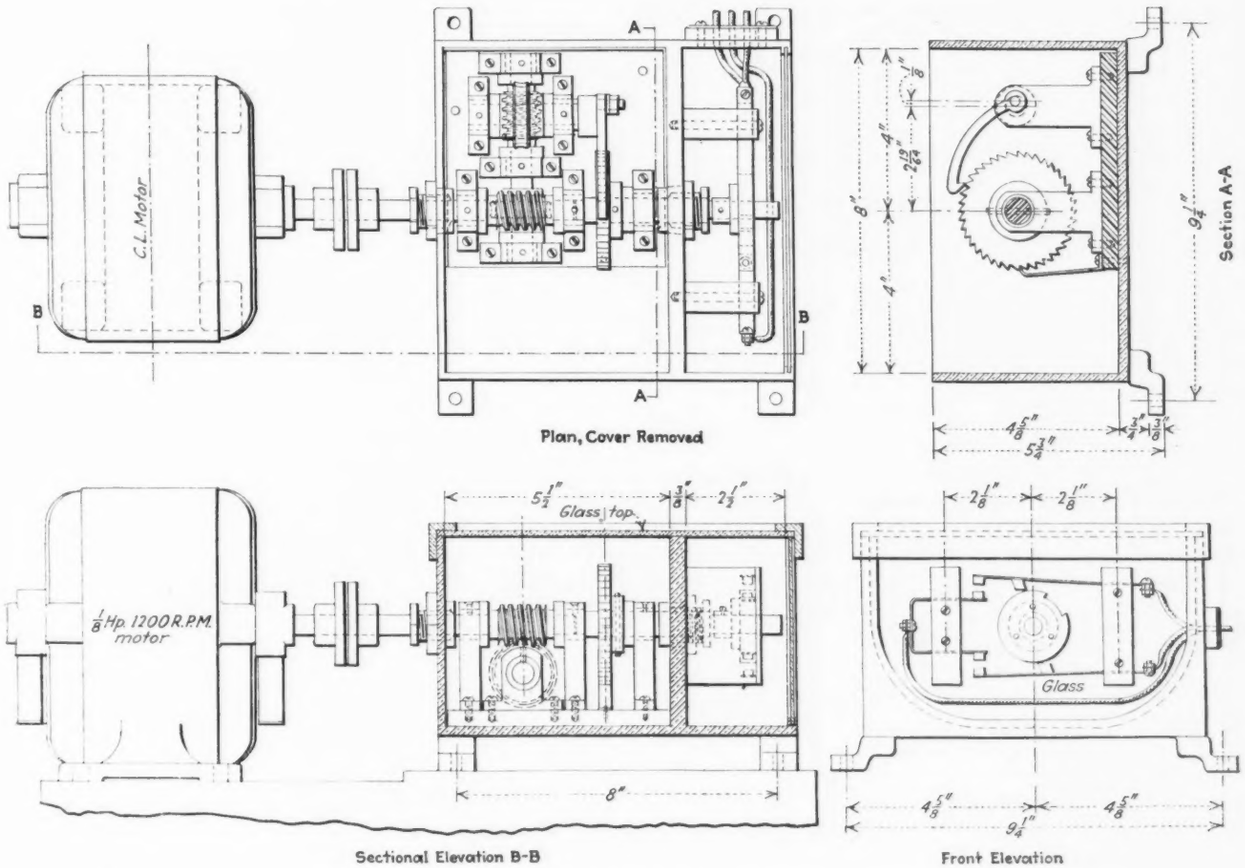


Fig. 1—Master timing control for automatic samplers

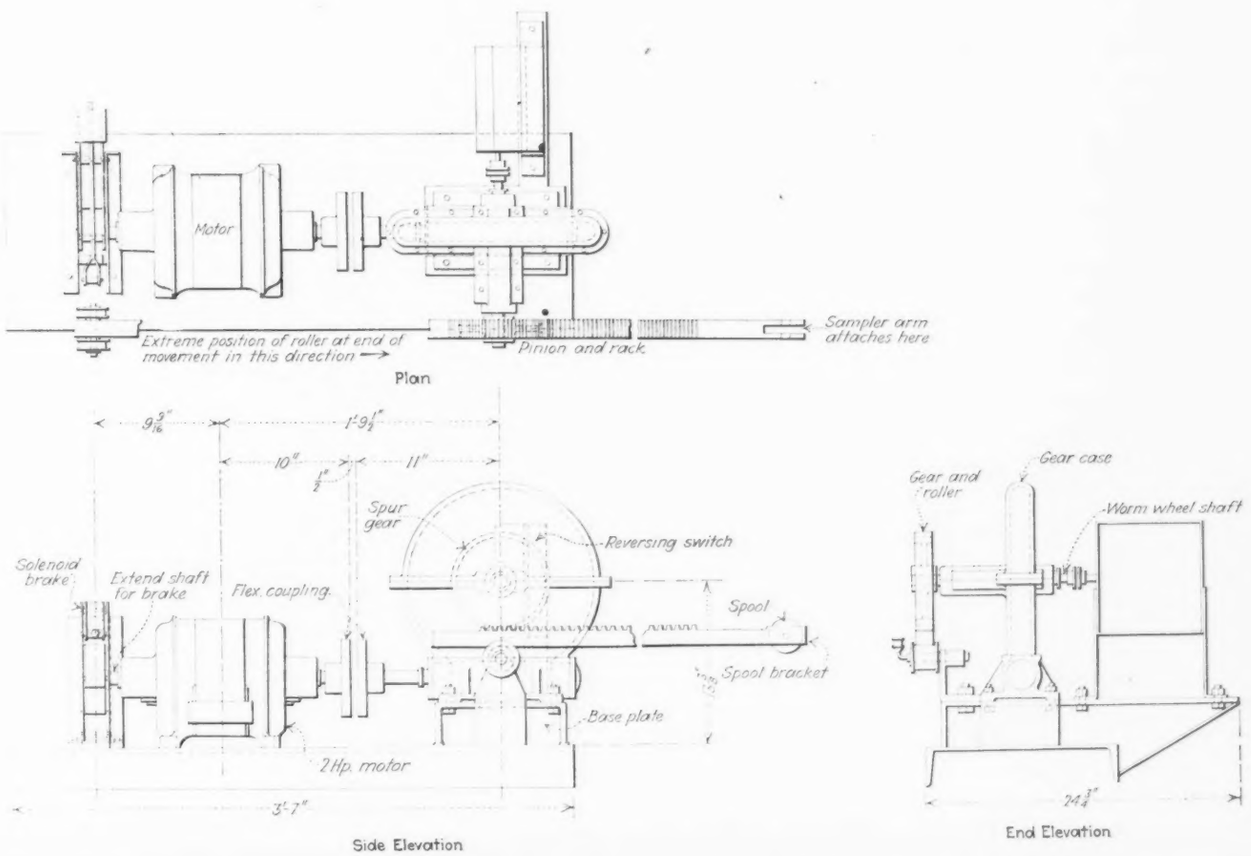


Fig. 2—Driving rig for automatic samplers

Discussion

Capital Scarce for Mining

THE EDITOR:

Sir—I have a partner here, a Mr. C. P. Haight, the editor of our local newspaper, who during the week runs lead through a Mergenthaler and hunts gold on Sundays. Together he and I generally furnish beans and bacon enough to keep one or two prospectors in the hills. We have forsaken placer mining now for hard rock, and have been successful in a small way several times.

Even when we find a good prospect we are financially unable to develop it properly. We are like thousands of other small fry. We can and do spend our last dollar, keeping the prospector's pick busy, but when we find anything that has real merit and warrants money for development and machinery, how are we going to get it? We might possibly interest some promoter who would reluctantly take hold of it for us and also about 80 per cent of the ownership along with it. He would place some man in charge who has neither business ability nor the least idea how to handle a mine. The promoter would take about 20 per cent right off the bat for getting the cash and then the so-called mine superintendent would waste another 50 per cent or more, and the mine and section of country will get a black eye because it did not pay. I have a half interest in a property now which has been handled in just this way. For the stockholders to get their money back, the mine would have to be sold for more than it is worth. Four times enough money was spent to place the property on a paying basis. Had we been able to raise this money ourselves we would not have had to give up control, and could have paid back any loans needed to complete the milling equipment. Thousands of tons of good milling ore are in sight and no money to start taking it out. I am giving this only as an example of thousands of similar cases all through our mining section. It is true that many mines have paid good dividends, but in all cases the management has been responsible. Capital has become afraid of gold mines as safe investments. Can you blame the capitalists?

My partner has a classmate who now is a multimillionaire, owner of a great daily newspaper, interested heavily in one of the great city banking institutions. Some time ago he wrote him asking if he knew of some one who might be interested in helping us develop some prospects that we had. The banker answered that he did not, and that as far as he was personally concerned he was mighty leery of any mining proposition, and that my partner's letter sounded like all other "nut" letters he received.

It seems strange to me that capital could not be made available for loans to mine owners as in all other lines of legitimate business. The farmer and the merchant get all the money they need—more, sometimes, than is good for them. Stock can die, crops can fail, and merchandise stocks burn up. I do not see why an institution organized in detail as most great banking houses are could not make a success of loaning money to mines. I understand that the State of Washington is working on some such plan to assist just such people as myself and further to develop the state's mineral resources. Private capital could be much more logically and economically handled, I believe, because the state money would be spent more or less through political influence and incompetent executives would be selected, thereby branding the whole scheme as impracticable. Good for the State of Washington any way! She is trying to do something, which is more than one can say for the financial center of Oregon.

I. B. HAZELTINE.

Canyon City, Ore.

A Prospect in Mexico

THE EDITOR:

Sir—Being a prospector, struggling with a prospect here in Mexico, it is of much concern to me to know if there is a way to interest anyone in a prospect. The many articles in your magazine relating to mine promotion have been read with much interest, but the conclusion seems to be that principally only the hot-air promoter's method gets results.

I have advertised a few times in the "Searchlight Section" of the *E. & M. J.* for a partner or assistance for development of my prospect. The ads. always brought results so far as inquiries may be called results, but invariably my proposition has been turned down because my prospect was in Mexico. "The unsafe condition of the country, too many bandits, too far from transportation; and had your prospect been in the States we should be glad to join you; but Mexico, No!" These rather unsound reasons have generally been the stumbling block on which my propositions have fallen down. What is the matter with Mexico, as to the operation of mining property, anyway? Nothing much, as far as I can see, if a person is able to accustom himself to the ways of the country. It is quite true a person labors under many disadvantages here, but, on the other side, he also enjoys some advantages that he would not meet in other places. As stated in your editorial of July 24, "Mexico Again," if the disadvantages are all put in the scale they are outweighed by the advantages.

My prospect is in the northeastern part of the State of Sinaloa, in the Durazno Mountains. I am working it as best I can and manage to get out gold enough to keep up the taxes and buy a little grub once in a while, but the best I can do is just to keep the wolf from the door. The ore is free-milling and easily worked, but of rather low grade. As I can mill or work only a ton or two of the ore through my little home-made outfit in a week, it is impossible for me to get ahead enough to be able to buy tools and equipment needed. If I could find someone who would come here to Mexico and work with me and equip the prospect with a small plant, a nice steady income could be had, which would add greatly to the pleasure of this interesting life in Mexico. This prospect may never turn in to be a great bonanza, but it can be made to pay its own way, and it is a prospect of merit with all earmarks of a good mine.

I have 10 pertenencias, or about 25 acres, but much

more mineral ground could be taken up as extension. The country rock is quartzite and other metamorphic rocks, intruded with porphyry and granite. The vein is a "manta" or blanket vein and probably a replacement deposit. The vein material is calcite and soft porous quartz with red oxide of iron. The orebody has a width or thickness of from 2 ft. to 8 ft., with an average of about 4 ft. In places the ore occurs in caves or chambers with an empty space of a foot or more between the quartzite roof and the ore. This ore is of a soft granulated material, easily dug out with shovel alone. The ore averages around $7 in free gold to the ton. I am treating it by amalgamation. High-grade copper ore, associated with silver, lead, zinc, and pyrite, also occurs near or in these chambers or cavities.

The work done on the place consists of a prospect tunnel, 100 ft. deep, and gophering in a few places, altogether to an extent of about 80 ft. up to this date. All work has been in ore from the surface. The mine is quite foolproof and a poor man's mine.

The best suggestion I can give the person who may wish to come here would be for him to take a vacation trip to Mexico and look things over himself. Should he not like my little prospect, or Mexico in general—well, his vacation would at least have been quite interesting and beneficial, as far as giving him a change of scenery is concerned. A trip to Mexico would not cost more than a winter vacation spent in Southern California, Florida, or Cuba or some other good place. I must not forget to mention that I am situated about 75 miles from a railroad station, and only half of the way can be made by auto. However, I take it for granted that the person who will consider a trip into the mountains of Mexico enjoys mule- or horse-back riding and takes this kind of traveling as a pleasure.

Palmar de Sepulvida, ALF ENKEBOLL.
via Mocorito, Sinaloa, Mexico.

Public Roads and Assessment Work

THE EDITOR:

Sir—The editorial, "Public Roads and Assessment Work," which appeared in the Nov. 20, 1926, issue of the *Engineering and Mining Journal*, inferred that two legal questions were involved which had not been settled by the courts. In Sexton et al. v. Washington Mining & Milling Co., 104, p. 614, the question was:

"Can the construction of a road, without the boundaries of a mining claim, be credited as assessment work upon such claim, such road providing access to such claim and others contiguous thereto, and being built for the benefit of mines and mining claims in the district?"

The court said:

"So that, independent of the statute, there could be little doubt but that the performance of this labor in the construction of a road aiding in the general development of the combined properties would be a full compliance with the statutory requirement as to assessment work. Such is the holding in Doherty v. Morris, 17 Colo. 105, 28 Pac. 85."

In Golden Giant Mining Co. v. Hill, 198, p. 276, the above case was cited as follows:

"In Sexton v. Washington, etc., Co., 55 Wash. 389, 104 Pac. 614, a road built into a small unorganized mining district by all the miners owning claims it was held might be considered as work upon and for the development of all such claims, citing with approval Doherty v. Morris, 17 Colo. 105, 28 Pac. 85. This case certainly goes to great length in the application of the doctrine in regard to roads serving as annual assessment work."

Here are found two decisions agreeing that "the construction of a road aiding in the general development of the combined properties . . . by all of the miners owning claims" is a full compliance with the statutory requirements as to assessment work.

In Sexton et al. v. Washington Mining & Milling Co., the evidence was to the effect that the road in question was constructed by the owners of and for the benefit of the mines and mining claims within the mining district—a public road?—a situation analogous with Elk City, Idaho.

In Florence-Rae Copper Co. v. Kimbel, 147, p. 881, the court held that work done for a railroad company in association with a mining company would apply as annual labor under Sec. 2324 R.S.U.S. (U. S. Comp. Stat. Sec. 4626.)

As the courts have held that the work done on a jointly constructed road—a public highway—and a railroad—a public utility?—would apply as annual labor, were the citizens of Elk City within their province in passing the resolution? They erred in using the term "trunk road," as this road does not come within the definition of "trunk road" and had been, previous to the passage of their resolution, designated as a "forest highway."

The South Fork of the Clearwater River Highway (Elk City National Forest Highway) is being constructed by the Forest Service in co-operation with the Grangeville highway district and local aid. It is not coincident with the Federal Aid System and does not become a part of the State Highway System until two years after it is completed to Elk City.

Is a legal question involved upon which the General Land Office has not ruled? Under "Performance of Work" and "Jurisdiction to Determine," U. S. Bureau of Mines, Bull. 94, Part I, United States Mining Statutes Annotated by J. W. Thompson, Section 2324 R.S.U.S. (U.S. Comp. Stat. Sec. 4626) p. 253, says:

"The annual expenditure in labor or improvements required by this section is solely a matter between rival or adverse claimants and goes only to the right of possession, and the determination of this question is committed to the courts in a proper proceeding and will not be decided by the Land Department.—Wolenberg, In re, 29 L.D. 302, p. 304. Beik v. Nickerson, 29 L.D. 662, p. 665. Maxburg Lode Min. Claim, In re, 30 L.D. 202, p. 208.

"The determination of the question of the annual expenditure and the right of possession as between rival claimants is committed by the mining laws to the courts.—Cain v. Addenda Min. Co., 29 L.D. 62, p. 66. Wolenberg, In re, 29 L.D. 302. Barklage v. Russell, 29 L.D. 401, p. 402.

"The Land Department has nothing to do with settling questions as to the performance of annual expenditure upon mining claims, nor of the alleged relocation thereof because of the failure to perform the annual assessment.—Cain v. Addenda Min. Co., 29 L.D. 62. Wolenberg, In re, 29 L.D. 302. Barklage v. Russell, 29 L.D. 401. Wolenberg, In re, 29 L.D. 488, p. 489. Gaffney v. Turner, 29 L.D. 470, p. 474. Poore v. Kaufman, 44 Mont. 248, p. 257; 119 p. 785."

It was not anticipated that my opinion on this subject would be given publicity, nor was it intended to give the effect of a legal opinion to stop the citizens of Elk City from getting correct legal advice. It was merely my expression, and I fully realized that it was an infringement upon an attorney's prerogative. However, as the editorial has been commented upon and reproduced by the local press, I trust that the foregoing will be accepted in the spirit in which it is submitted—the outcome of an extenuating circumstance.

STEWART CAMPBELL.
State Mine Inspector, Boise, Idaho.

News of the Week

Summary

INSPIRATION reaches highest capacity in its history, 22,000 tons a day, and ships first cathodes from the new leaching plant to Perth Amboy for melting.

British Columbia mines are generally operating at capacity, with some development of small properties.

Bureau of Mines and Geological Survey should have increased budgets, say legislators from mining states.

High-grade ore has been found in the White Caps mine, in Nevada; metallurgical treatment difficult.

U. S. Smelting shares in the activity in the Rouyn area of Quebec and finds promising copper prospect.

Chilean nitrate producers so far unsuccessful in meeting competition with synthetic compound.

E. P. Mathewson's course in mining administration attracts "old grads" in Arizona.

Partly fired charge explodes with fatal results when bitten by steam-shovel tooth.

Finding of free gold in the Kubli mine, southwestern Oregon, encourages owners of other properties.

Progress made in supplying British consumers with manganese ore from Australia and India.

Rosiclare Fluorspar Employees Stage Safety-First Contest

Excellent Work by Four Teams—Lost-Time Accidents Reduced in Number

An engraved silver cup, 18-in. high, was the award for the first-aid contest held by the employees of the Rosiclare Lead & Fluorspar Mining Co. held at Rosiclare, Ill., on Nov. 27. Four teams contested, the winners having a percentage of 99 and the lowest team 95.6. Winning the cup three successive years will give permanent possession.

C. M. Fellman, general superintendent for the company, in June, 1925, arranged a visit of the Bureau of Mines rescue car from the Vincennes (Indiana) station. It remained at Rosiclare for three weeks. During that time about fifty Rosiclare employees were trained and at the same time employees from the Hillside and Franklin company mines, together with men from all walks of life in the community. Following this visit and training seven employees were chosen from the Rosiclare company's force to constitute a first-aid team representing the Rosiclare company at the International First Aid contest held at Springfield on Sept. 10, 1925. The Rosiclare company team was awarded at this meet a position in the upper third of all teams competing from all over the country. Following the contest a first-aid instructor was appointed to hold regular classes and instruction each week, whereby all the employees have received training and instruction. This work has been directly responsible for a considerable decrease in the number of accidents and time lost among employees during the year 1926 as compared with former years.

Judges at the recent contest were Alex Miller and Mr. Kessler from the Bureau of Mines Rescue Station, Vincennes, Ind.; Frank Patterson, State Mine-Rescue Station, Eldorado, Ill., and Mr. Towal, safety engineer of the Dupont Powder Co. All members of the competing teams were awarded fobs with a Winged Victory design, and suitable inscriptions on the back of the fobs.

In addition to the first-aid company contest there were several boxing, wrestling, and tug-of-war matches between employees also and between teams representing the surface and underground departments.

North Butte Equips New Shaft

The North Butte Mining Co. has ordered 2,200 ft. of 12-in. pipe to be used as a water column at its east side property at Butte, Mont. This will be installed immediately and at the same time larger pumps will be put in place and developments started on the 2,200 level, to tap the orebody east of the Continental fault which was encountered on the 2,000 level.

Paul A. Gow, manager, states that over 160 leasers and employees of leasers are working in the "hill" properties of the company and producing about 3,700 tons of ore per month, of which 80 per cent is copper ore and the remainder zinc ore. More leases will be given out, as the leasing plan is working very well. The company recently leased its Birtha claim, from which the leasers are shipping a good grade of oxidized copper ore to the reduction works.

C. & A. Adds to Its Holdings in Lordsburg District

The 85 Mine, owned by the Calumet & Arizona Mining Co., of Warren, Ariz., has just purchased the Cobra Negra group of claims from the Susquehanna Mining Co., and the Atwood group, both of which adjoin its holdings in the Lordsburg district, New Mexico. Announcement of the program of the C. & A. interests is expected soon.

Rich Ore Reported in White Caps Mine, in Nevada

Manhattan Property, Long Idle, May Resume—Refractory Ore Problem May Be Solved

A rich and probably important ore discovery has been made on the 1,310 level of the White Caps mine, in the Manhattan mining district, 50 miles north from Tonopah, Nev. A narrow width of good ore was reported on this level about two months ago, but it was not regarded as the downward extension of the main orebody, as developed on the upper levels.

The new strike is believed to be the main oreshoot, and reports from the mine are to the effect that a crosscut has penetrated the orebody a distance of 34 ft., with an average value for the entire distance of $54.60 per ton. If drifts show any extensive length to this orebody it will be one of the most important developments in this section in many years. This oreshoot has been developed on upper levels, though no stoping has been done, the mine having been on a development basis only for several years.

The 100-ton mill was closed down because of the refractory nature of the ore, which, especially on upper levels, below the oxidized zone, contained both arsenic and antimony. The ore was cyanided after roasting, but losses in tailings were excessive, and it was thought best to conduct an extensive development campaign before making further expensive changes in the mill. Arsenic and antimony content have decreased with depth, but is still present. Extensive metallurgical tests are now being conducted, and it is thought that mill changes will be made and milling resumed in the spring or summer of 1927. In the meantime the development work will be continued in the mine, in preparation for such changes in the mill as will make full operation practicable.

Inspiration Ships First Copper from Leaching Plant

ON NOV. 26 the Inspiration Consolidated Copper Co. shipped its first carload of cathode copper, weighing 100,000 lb., from the new 7,500-ton leaching plant to Perth Amboy, N. J. The copper will go by rail to Galveston, Tex., and from that port to New York Harbor by water.

In this connection it is unofficially stated that about 22,000 tons of ore is being handled daily at the Inspiration mines, on some days as high as 22,500 tons being produced. This production is the greatest in the history of the mine, being slightly over the maximum capacity of the concentrator when it was being pushed to its utmost during the war.

Sheldon Mining Co. Increases Mill Output in Arizona

At the property of the Sheldon Mining Co. at Walker, Ariz., steady progress has been made in underground development. Consistent improvement in the size and value of the orebodies at depth is reported to the stockholders. The No. 4 oreshoot, to the south of the main shaft, and opened up for 300 ft. on the 650 level during last winter, has now been reached on the 850 level. Drifting to the south on the 750 level to reach the same orebody is about to begin. To the north of the shaft the drifts on the 750, 850, and 950 levels, the latter through the winze sunk last fall, have also been extended with satisfactory results.

Development work underground, between Jan. 1 and Sept. 1, had increased the ore reserves on the latter date to 100,000 tons, on a conservative estimate. This is an addition of 25,000 tons to the reserves on the first of January, 1926. At the same time, during the intervening eight months, approximately 13,000 tons was taken out and milled.

Up to Aug. 15 the mill operated on one shift only, the production of raw ore continuing on the basis of about 60 tons per day, except for a two-week period in June, during which time the mine was closed down while the new hoist was being installed. Except for the cost of development, this small output more than paid all expenses.

On Aug. 15 the mill was put on a two-shift basis, the mine production having been brought up to 100 tons of ore per day, or 3,000 tons per month. On the increased tonnage, September and October show a substantial profit, after deducting cost of development and all other charges.

A new double-drum hoist, with counter balance, has been installed at a cost, complete, of $8,000. This hoist was specially built to meet requirements, and is capable of operating to a depth of from 1,200 to 1,500 ft., and of hoisting 200 to 300 tons of ore per day. This will be adequate to meet the needs of the mine, it is thought, for several years.

Verde Central Makes Progress

The shaft at the Verde Central property, at Jerome, Ariz., has been continued to a depth of more than 1,900 ft. and a station is being cut at this level. The station will be one of the largest in the district and will be completely equipped. It will be of solid concrete construction throughout and will house the battery of new pumps which will be installed at once, and will also accommodate a power plant and other necessary machinery.

Work at the property is proceeding at a rapid rate. It is understood that encouraging conditions have been found on the lower levels of the mine.

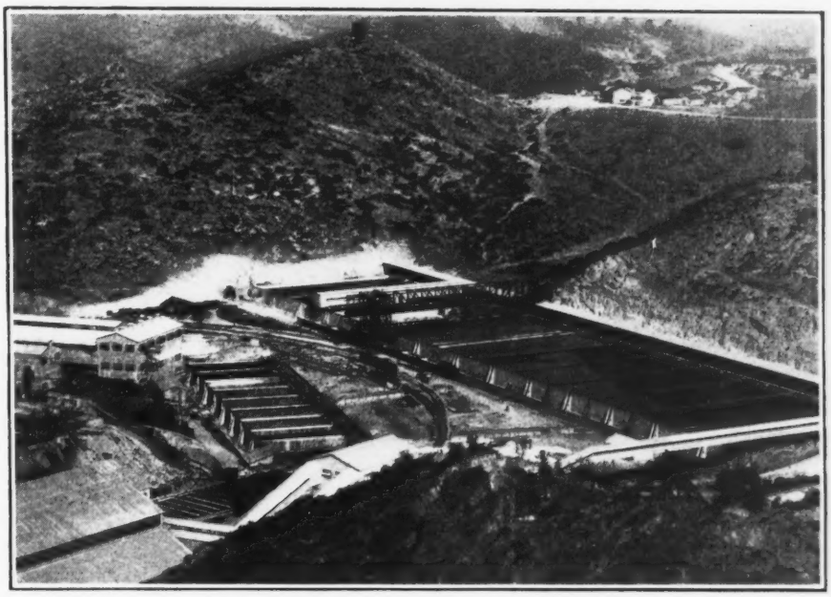
Attorney Gets $28,000 Judgment in Lieu of Shares

Gilbert Property in Nevada Attached—Rich Ore Reported Just Before Shutting Down

The Gilbert Mammoth Last Hope Mines Co., which owns the original strike in the Gilbert gold district, about 30 miles northwest from Tonopah, Nev., is in trouble, which has resulted through error in action by the board of directors about a year ago. It appears that B. F. Curler, an attorney for the company and one of the directors, had been promised 35,000 shares of stock in the company as remuneration for his services as attorney. This stock, which was to have been delivered to Curler on Oct. 8, 1925, was canceled by action of the board of directors. Curler brought suit to recover the stock or a money judgment, and in a recent decision by Judge Dunn, of the District Court of Nye County, Curler was awarded a money judgment of $28,000, plus costs and interest from Oct. 8, 1925. The market value of the stock at that date was 80c. per share, and as Curler was to have received his stock at that time this figure was used by Judge Dunn in arriving at this $28,000 figure. The mines and personal property of the company were attached on Nov. 19 by Curler to protect his judgment.

The mine was closed down late in August after rather a stormy career of many rich strikes and very limited production. Rumors have been circulated to the effect that a very rich orebody was cut in the mine before it was closed down.

It is considered probable that, at the annual stockholders' meeting called for Dec. 6 in Tonopah, some plan will be presented which will provide for payment of debts and financing for future operations, though no announcement of the plans of the management of the company has been made public.



New leaching plant of the Inspiration Consolidated Copper Co. from which the first copper has just been shipped

Shoot 5 Ft. Wide of $100 Ore in San Rafael

An important development is reported on the 350 level of the San Rafael mine, in the Broken Hills-Quartz Mountain district, 60 miles northeast from Luning, Nev. The new strike was made in the Lease vein and opened through an east crosscut from the footwall vein workings, and is undoubtedly a downward continuation of the ore cut in a raise from the same crosscut a few weeks ago. As exposed in the crosscut the ore is 5 ft. wide and runs $100 per ton in silver and lead, with a little gold, which is higher in grade than the average San Rafael mine ore.

Drifting so far done on the 350 and 450 levels has failed to open commercial ore, but work is being continued under conditions which are regarded as favorable to the development of material that can be handled profitably.

In the Calico mine, to the north of the San Rafael, and in the Quartz Mountain Metals, to the south of the San Rafael, veins have been encountered which carry low but not commercial values. Development in these properties is quite limited, as most of the work up to this time has been confined to shaft sinking.

Not Miners but Capitalists Visiting Butte Mines in Digging Clothes

AFTER the auction sale of the Chicago, Milwaukee & St. Paul Railroad at Butte on Nov. 22, the Eastern capitalists and executives who had gone west for the sale took a trip down the Leonard mine of the Anaconda Copper Mining Co. The party was in charge of John Gillie, formerly manager of mines; Chauncey L. Berrien, superintendent of mines; Charles J. Kelly, Jr., son of the chairman of the Metals Bank & Trust Co.; and J. Carlos Ryan, son of John D. Ryan.

The accompanying picture shows the financiers and mining men ready to go underground: The men are, left to right, sitting: Pierpont V. Davis, vice-president of the National City Co.; Guy Carey, attorney for bondholders; H. H. Field, head attorney for the Chicago, Milwaukee & St. Paul Railway; Jerome J. Hanauer, of Kuhn, Loeb & Co.; W. A. W. Stewart, of United States Trust Co., of New York. Second row: J. Carlos Ryan; F. H. Ecker, vice-president of the Metropolitan Life Insurance Co.; Herbert Lundahl, master in chancery who auctioned the road. Third row: E. S. S. Sunderland, counsel for the Guaranty Trust Co., of New York; Robert F. Swaine, attorney for reorganization managers; Chauncey L. Berrien; Ralph Shaw, attorney for bondholders; Donald C. Swatland, attorney for reorganization managers; Charles Kelly, Jr., and E. M. Norris. A gentleman with statistical leanings calculated that the visitors represented an aggregate wealth of $2,500,000,000, but that they saw one of a group of mines that had produced metal worth $2,000,000,000—interesting if true.

Mining Men Urge Speed in Idaho Highway Construction

The Clearwater country, in Central Idaho, said to be one of the richest known mineral regions in the United States, that has not been provided with the necessary transportation to open it, is being "approached" by a state highway slowly building into it, and mining men are now making a concentrated effort to hasten this construction so that the gold districts of the region will have transportation by the end of 1927, instead of being forced to wait three years, when the present construction program of the state will bring the road into the district.

Several properties are said to be ready for mills and production as soon this highway reaches Houston, and the state will be urged to hasten construction on the ground that it can well afford to do this because it will open a mining district which can be expected to employ several hundred men. This region was in the '60s famous for its gold placer mining.

World's Largest Aluminum Plant To Supply Detroit

It is expected that a large proportion of the aluminum produced at the new Arvida plant recently built in Quebec, Canada, by the Aluminum Company of America, will be shipped to Detroit for use in the automobile industry. When completed this plant is to have the largest productive capacity of any aluminum plant in the world, according to present plans. A large quantity of copper will be required for its construction.

Keweenaw Silver Orders Plant Equipment

A plant has been ordered by the recently organized Keweenaw Silver Mines, Ltd., for its property at Cobalt, Ontario. The plant will be driven by electricity, and once it is installed a shaft will be put down to the Keewatin contact. The Keweenaw Silver Mines is an amalgamation of the Red Jacket property, the A-6, and four other claims. About 500 acres go to make up the property, but it is understood that only about 50 acres of this is conglomerate. Some of these claims were worked in the early days before the geology of Cobalt camp was well known.

The mining property is situated about a mile from the McKinley-Darragh holdings.

Twenty-two Ship Custom Ore to Consolidated M. & S.

Shippers of custom ore to the Trail plant of the Consolidated Mining & Smelting Co. of Canada numbered twenty-two during the week ended Nov. 21. Of these ten contributed milling ore which is handled in the company's concentrator.

Following is a statement of ore received for the period from Nov. 15 to Nov. 21, inclusive:

Name of Mine	Class	Locality	Tons
Allenby Copper	Copper conc.	Allenby, B.C.	442
Alamo	Milling ore	Alamo	31
Aurora	Milling ore	Aldridge	89
Galena Farm	Milling ore	Silverton	86
Lucky Jim	Milling ore	Zincton	621
Monitor	Milling ore	Three Forks	44
Rambler	Milling ore	Rambler	28
Stemwinder	Milling ore	Kimberley	1,079
Trade Dollar	Milling ore	Sandon	41
Whitewater	Milling ore	Retallack	97
Wonderful	Milling ore	Sandon	58
			2,174
Bluebell	Lead conc.	Riondel	64
Canadian Group	Lead ore	Sandon	42
Sally	Lead ore	Beaverdell	45
Wellington	Lead ore	Beaverdell	33
			184
Bluebell	Zinc conc.	Riondel	59
Metals Recovery	Zinc conc.	Retallack	45
Van Ro	Zinc conc.	Silverton	40
			144
Last Chance	Dry ore	Republic, Wash.	346
Quilp	Dry ore	Republic	380
Tredway	Dry ore	Hazelton	33
Yankee Girl	Dry ore	Ymir, B.C.	360
			1,119
Consolidated M. & S. mines			9,756

Plutocrat Find May Mark New Era at Cripple Creek

The discovery of rich samples at the surface in the Plutocrat claim at the apex of Mineral hill, north of Cripple Creek, Colo., has caused a demand for acreage in this section that has raised the price of claims from a few hundred dollars into the thousands.

Nickolai & Jensen, of Cripple Creek, lessees of the Plutocrat, revived the interest when they found rich pieces of float at surface on the north slope of the hill. By driving a series of trenches along the hill, panning the rock and dirt as they worked, they uncovered an area 50 ft. square from which a carload was mined from grass roots, that settled for a good price at the Golden Cycle mill at Colorado City.

Teller County, where Cripple Creek is situated, has been beneficiary by thousands of dollars in back taxes paid the last two weeks on the territory of Mineral Hill, and a new era of Cripple Creek mining may be at hand.

Tonopah Output $150,000

Production of the Tonopah mining district, in Nevada, for the month of October was valued at $150,000. No important developments or discoveries were reported from this the most important silver district in the state. November production has been adversely affected by the delays due to temporary discontinuance of power service. Electric power for this section of Nevada is brought in from plants in the Sierra Nevadas, and storm trouble is common where the transmission line crosses the White Mountains.

Big British Columbia Mines Busy

Cold Weather Hinders Power Co.—Consolidated Looking for Copper—Granby at Capacity—Silversmith Stocks Silver-Lead Concentrate

By F. H. Mason
Victoria, B. C.

MINING OPERATIONS of all the large companies in British Columbia are at capacity except for brief interruptions. Zero weather for a few days in the East Kootenay district, followed by a thaw, has filled the Bull and Elko rivers with floating ice and has harassed the East Kootenay Power Co., which supplies power to the Sullivan and St. Eugene mills, to such an extent that the Sullivan mill had to be closed for two days and the St. Eugene mill still is closed. The latter mill has served a versatile series of purposes since its completion, at a cost of around $750,000. It was used for several months to treat middling from the Sullivan mill, but later, when a plant for this purpose was erected at Kimberley, it was used to re-treat tailing from the old gravity mill, which was burned several years ago, the tailing being raised from the bottom of a lake by a dredge. Heavy crushing machinery now is being erected, and when this is in place the mill will be used to treat sorted ore from the old waste dumps at the St. Eugene mine while the lake containing the tailing is frozen over. It may be used, also, to treat custom ore from the near-by mines.

Power house, showing generator room and blowers, Granby Consolidated Mining & Smelting Co., Anyox, B. C.

The Consolidated Mining & Smelting Co. of Canada has bonded the Voigt group of claims, adjoining the Allenby Copper Corporation's property, on Copper Mountain, and it acquired by purchase at a recent tax sale twenty-one claims in the vicinity. The Allenby property is controlled by the Granby Consolidated M. & S. Co. It is reported that the Consolidated will re-condition the camp and thoroughly explore the claims with diamond drills. Emil Voigt has held the claims for several years and has done a good deal of shallow exploration; the surface indications are said to be as good as were those on the Allenby Copper Corporation's claims.

The Coast Copper Co., a subsidiary of the Consolidated company, has had forty to fifty men steadily employed in development at the Old Sport mine, at Quatsino Sound, in the north of Vancouver Island, and in survey for a railway from the mine to the east coast of the island. A survey for a water-power plant has been made on Raging River, to supplement the plant that is in operation on Canyon Creek. The company has been steadily developing the Old Sport mine for several years, and, undoubtedly, a large body of copper ore has been developed, though exactly how large is not known, as it is against the policy of the Consolidated to give any information as to its ore reserves, costs, and recoveries. These activities would seem to indicate that the Consolidated, having nearly completed its program of lead and zinc development for the time being, at any rate, is about to turn its attention to copper mining.

The Granby Consolidated Mining, Smelting & Power Co. is operating its Anyox plant at capacity, and is turning out around 3,375,000 lb. of blister copper per month, while its subsidiary, the Allenby property, now has its mill running at capacity, and is turning out around 1,500,000 lb. Deep exploration by diamond drilling on Copper Mountain is reported to have indicated a considerable reserve of a better grade of ore. The Allenby company is making a series of large settling pools, so that it may return to the river free from slime the water taken from the

Similkameen River for ore dressing, and thus obviate trouble threatened by farmers owning property contiguous to the river and from fish wardens.

The Britannia Mining & Smelting Co. is operating its mill at a capacity of 3,300 tons of ore per day, but it appears to be putting through a rather lower grade of ore, as its copper output, which was running around 3,000,000 lb. per month, has dropped to about 2,650,000.

During the period of silver depression Silversmith Mines has decided to concentrate its energies on development and to curtail output. It will hold its silver-lead concentrate for a better market, but probably will continue to sell its silver-zinc concentrate, which contains a far lower silver content than the lead. The company followed a similar policy in 1922, after paying its first dividend, and at that time shipped no ore for nearly a year.

The Premier Gold Mining Co. is operating its mill at better than its rated capacity of 400 tons per day; it is putting through on an average 430 tons and it is shipping around 230 tons of crude ore per day.

The activity in mining in the Kootenay and Boundary districts is shown by the ore receipts at the Trail smelter. These reached 516,047 tons for the year up to Nov. 21, far exceeding the record of any previous full year. The Consolidated company's mines contributed 368,147 tons, and 115 mines, of which 90 were in the Kootenay and Boundary districts, supplied the rest. The chief independent shippers were: the Allenby Copper Corporation, 31,068 tons; Lucky Jim, Zincton, 17,161 tons; Stemwinder, Kimberley, 15,704 tons; Yankee Girl, Ymir, 15,116 tons; Bluebell, Riondel, 14,277 tons; Whitewater, Retallack, 8,571 tons; Quilp, Republic, 7,313 tons; McAllister, Three Forks, 6,014 tons; Silversmith, Sandon, 5,400 tons; Last Chance, Republic, 4,010 tons; Duthie Mines, Smithers, 2,510 tons; Cork-Province, Zwicky, 2,217 tons; Trivett, Republic, 1,922 tons; Aurora, Aldrige, 1,738 tons; Homestake, St. Louis Creek, 1,410 tons; Galena Farm, Silverton, 1,285 tons; Ruth-Hope, Sandon, 1,038 tons; Sally, Beaverdell, 1,024 tons; Metals Recovery, Blaylock, 984 tons; Bell, Beaverdell, 932 tons; and Paradise, Lake Windermere, 745 tons.

The Metals Recovery Co., which has been treating the tailing from the old Whitewater mill, has shut down.

Car of Ore from Mabel Mine Averages $234

The West End Consolidated Mining Co. has reported shipment of Lot 65, of 45 tons, from its Mabel mine, 20 miles northwest from Mina, Nev. This car is estimated to run about $150 per ton in silver, gold, and lead. The last car, Lot 64, ran $234 per ton, and was the richest ever shipped from the mine, the average for the first 64 cars being $120 per ton.

Development work is being carried on from the 300 and 500 levels, with most of the ore being mined from a rich but narrow stope above the 300 level. Small bunches of very rich free-gold ore have been encountered at two widely separated points on the 500 level.

Washington Letter

By Paul Wooton
Special Correspondent

Universal Importance of Mining Is Budget Argument

Hammond Address Source of Material for Advocates of High Appropriations for Bureaus

Legislators from mining states regard as insufficient the sums specified for the Bureau of Mines and the Geological Survey in the budget presented to Congress Dec. 7. It is not enough, they hold, to carry out the work for which the mining industry is calling.

It is known definitely that a determined effort will be made in Congress to override the budget in this instance. To this end use is to be made of the remarks of John Hays Hammond at the Pittsburgh conference on the utilization of bituminous coal. In that presentation he referred to the need for fundamental research into underlying science and into practical problems of mining geology and engineering.

The text of Mr. Hammond's address will be printed in "The Congressional Record," and members from mining states will try in other ways to direct the attention of their colleagues to certain parts of that speech. Emphasis will be placed upon Mr. Hammond's exposition of the absolute dependence of modern industry on the minerals, including the mineral fuels, and how the outstanding feature of American industrial development is the increasing use of power. The per-capita consumption of energy in the United States is ninety times as great as it is in India and three times as great as in most of the countries of Europe.

Senator Oddie, who is leading the movement, is struck with the complete case that Mr. Hammond unwittingly made for those who are demanding more co-operation on the part of the Federal Government in the solution of the problems which confront the mining industry. Some of Hammond's points which have been selected for use in the drive for increased appropriations for mining are:

The increased use of power has made possible the high productivity of the individual American worker and the rise in the standard of living. In the manufacture of pig iron the output per worker has increased seven-fold since 1900. In the automobile industry it has trebled in the last twelve years. Increased dependence on minerals is shown by the fact that in the last century, while the white population was increasing only threefold, the production of copper increased sixtyfold; of mineral fuels, seventy-five fold, and of pig iron 100-fold.

The maintenance of this enormous consumption of products of mines depends on engineers and scientists. It will be a long time before the day of absolute exhaustion of these resources, but in the meantime there is the immediate tendency for the natural difficulties in mining to increase. As the mines get deeper and the richer materials are extracted, utilization of lower-grade deposits will become necessary. An inevitable increase of cost and of price to the consumer would result were it not for the improvement of science and technology.

When oil was discovered in Oklahoma in 1906 the producing sands were 600 ft. below the surface. By 1917 depths of 2,400 ft. were common. In California a number of the newer pools were tapped at depths in excess of 5,000 ft. and in one recent instance oil was brought in at 8,102 ft. Science and technology have increased the output per worker in American bituminous mines by 67 per cent since 1890. They have reduced the fatal accident rate in British coal mines to one-fourth of what it was in 1850. In the gold mines of the Rand they have made possible a recovery of ore from great depths at a cost less than that which prevailed when the upper areas were worked thirty years ago. They promise to double or treble the recovery of oil from the sands.

The consumption of coal per horsepower hour was reduced from 10 lb. in 1820 to 1.4 lb. before the war. Since the war the advance has been even more rapid. The improvement in steam practice has increased fuel efficiency in the production of electricity by 54 per cent in the last six years. As a result of these contributions of research, the actual price of power to the consumer, in relation to other commodity prices, has been reduced in spite of the increased difficulties in mining. The scientist and the engineer stand between the consumer and higher prices of power and metals. The research needed is not only technical but economic. Research without considering the limits of costs and profits would be academic. Studies of market possibilities, requirements, and future demands are particularly important, it is contended.

United States S. R. & M. Finds Copper in Rouyn

The United States Smelting, Refining & Mining Co. has made a promising copper discovery on its claims in Boischaetel Township, in the Rouyn copper-gold district in the northwestern part of Quebec.

Following a geological survey, a crew of men was employed on trenching and stripping, with the result that a mineralized area of considerable size has been opened up. This particular group comprises 240 acres, in which the above-named company has a 65 per cent interest.

Further south, in the same township, an option is held on the Horne Reef property, comprising 600 acres. An option is also held on the Bruce claims in Montbray Township, consisting of 800 acres which adjoins the large group of claims held by the Consolidated Smelting and in the vicinity of the Nipissing and the Coniagas properties.

The United States Smelting, Refining & Mining Co. operates in Canada under the name of the Rouyn-Boischaetel Development Co., Ltd.

Chilean Nitrate Industry Continues in Depressed State

Production Less Than 60 Per Cent of a Year Ago—Fixed Price Policy Not a Success

Although the production of nitrate of soda in Chile, which declined steadily in each month of this year from January to September, improved slightly in October, depression in that industry still continues, states a cable received in the U. S. Department of Commerce from C. C. Brooks, acting commercial attaché at Santiago. The slight improvement is insignificant, however, for the October, 1926, production of 127,000 metric tons is exactly 100,000 tons less than that of October, 1925.

At the close of the month of October only forty nitrate plants were in operation in Chile, compared with 89 at the end of January, 1926. Authorities in Chile estimate the visible world's stocks of nitrate of soda at the end of October at 1,837,853 metric tons, which were approximately 330,000 tons more than the amount on hand Oct. 31, 1925.

Commenting on the nitrate situation, Harry Campbell, U. S. Consul at Iquique, says that little hope of improvement is felt in Chile for the remainder of the nitrate year ending June 30, 1927. Present agreements of the members of the Chile Nitrate Producers' Association terminate as of that date. Many important factors in the trade in Chile predict that free sales will then take the place of fixed price sales as heretofore maintained by the association, according to Mr. Campbell. They contend that the system of fixed prices was feasible and profitable so long as Chilean nitrate enjoyed a world monopoly, but that such a system becomes a signal failure when severe competition is to be met.

There has been much discussion among the nitrate producers of northern Chile regarding ways and means of stimulating the industry and of meeting the growing competition of synthetic nitrate, the production of which is said to be making considerable progress in Europe. A concerted effort was made by the producers to persuade the Chilean Government to reduce the export duty on nitrate, amounting to 5s. per metric quintal (22.4 lb.), the Nitrate Producers' Association offering to make reduction in price corresponding to the reduction in the export duty. However, the government has remained firm as to the duty, and the prices fixed by the association have been reduced only 1s. per quintal from the prices of the preceding year. Apparently this reduction has not been enough to stimulate sales to any great extent, for sales reported up to the end of October represent only about half the quantities sold during the corresponding period of last year.

Gibraltar to Extend Tunnel

The Gibraltar Sierra Mining Co. has acquired a lease to operate and option to purchase a group of unpatented placer claims near Johnsville, Calif. Permission has been given by the California State Corporation Department to the company for the sale of $30,000 worth of stock.

Rico, Colorado, Doing Well

The Rico Argentine Mining Co. shipped from Aug. 28, 1925, the date on which operations were resumed, to the end of the fiscal year July 31, 1926, a total of 5,170 tons, giving a gross return of $118,393, according to Fred Price's annual report to stockholders. Mr. Price is president of the company and general manager.

Now that the selective flotation plant of the International Smelting Co. at Rico, Colo., is operating, the management plans to ship 50 tons daily, which will net above all expense of milling, hauling, and mining a minimum of $500 daily. Sufficient tonnage has been blocked out to assure shipments at this rate for two years.

Tunnel Prospects Mosquito Gulch

Mike B. Burke, a well-known mine operator of Rico, Colo., recently became interested in the South Mosquito Gulch, near Leadville, Colo., purchasing and taking options on a number of claims in close proximity to the well-known South London mine.

South and a little west of the South London is located the Dempsey group, which is being developed by a tunnel which is in about 800 ft. This tunnel is located a few hundred feet above the Moffat tunnel, and to the west. The late David H. Moffat put down a number of diamond-drill holes in this section, with the result that he made the statement that he considered the Mosquito range to be a richly mineralized section. Mr. Burke's tunnel may demonstrate the soundness of Mr. Moffat's conclusions.

Western Apex Drifts in Ore at Oatman, Ariz.

The east drift of the Western Apex, in the Oatman district of Arizona, on the 700 level is reported to be still in ore as work progresses.

Timbering and repairing the No. 3 shaft of the United Eastern, through which the Western Apex plans to work, is going on steadily, and though it may yet take many weeks to reach the objective, the safeguarding of the big shaft will be found worth while.

As soon as the water level is reached it is the intent of the management to start the pumps and the bailers in an effort to expel the water and get to work on the crosscut. It is believed that little repair will be necessary below the water level, as the timbering was in excellent condition when work in that part of the property was discontinued.

Fourth Available Potash Site Designated

The Bureau of Mines announces that Judkin Station on the Texas & Pacific railroad, in the southwestern part of Ector County, Tex., has been chosen as the location of the area designated as fourth in order of availability for potash exploration purposes in the investigation being conducted by the Federal Government looking toward the development of ample domestic supplies of potash centers. Two strong showings of potash-bearing salts appear in cuttings obtained from the Connell 1 B oil well at points 1,300 and 1,600 ft. below the surface. The depth to the top of the salt is 1,000 ft.

Experience of Seven Totals 130 Years; Still Ready To Learn

SIX "middle-aged" mining engineers, each with many years of practical executive experience in the mining field behind him, have enrolled in the new course in the administration of mineral industries, which is conducted by Dr. E. P. Mathewson, at the College of Mines and Engineering, at the University of Arizona, at Tucson. Counting the instructor their total years of experience is about 130.

Among the men enrolled for the course are P. P. Butler, a graduate of McGill, who has had twenty years' experience as superintendent of the Phelps Dodge smelter at Douglas; W. N. Dixon, a graduate of the New Mexico School of Mines, who has had a wide experience with the American Smelting & Refining Co.; S. B. Goldbert, who has seen service in the Philippines, Peru, and this country; and F. K. Brunton, graduate of McGill, who has had many years' experience in metallurgy, mining and milling, both in this country and foreign nations.

Dr. Mathewson, director of the class, has been engaged in mining for the last forty years, fourteen of which he was general manager of the Anaconda Copper company's smelter at Anaconda.

The class alternately spends one month on the campus and an equal length of time in the field, studying the methods used in the big mining companies of the state. In these field trips the class makes a complete investigation of the technical methods, business, bookkeeping, and all administrative problems. The mining companies of the state are co-operating with the university in opening their plants and offices as laboratories for the class.

On the campus a specially arranged course, which includes business law, two courses in economics, which specialize in mining accounting, business in mining, public speaking, and a daily seminar under Dr. Mathewson, studying the duties of a mining executive, is prescribed for the entire class. This course they pursue for one month, when they again take to the field for practical study and investigation.

Melbourne Letter

By Peter G. Tait
Special Correspondent

Manganese Company Reports Progress in Railway Construction

Broken Hill Proprietary Involved in Financing Project—Deep Lode Gold Mining Ends in Victoria

Nov. 3, 1926—The secretary of the West Australian Manganese Co., Ltd., reports that good progress has been made in obtaining the necessary plant and materials for the preliminary work in connection with the construction of the new line from Meekatharra to the manganese deposits at Horseshoe, a distance of 86 miles. The company has a capital of £250,000 and the Broken Hill Proprietary Co., which has a contract for the supply of rails, holds an interest in the venture.

E. C. Saint-Smith has resigned his position with the Queensland geological survey and is now with Oriental Tin N. L. investigating alluvial occurrences in Malay and Burma. With the exception of six months when he was superintending prospecting operations for the Mount Isa Mines, Ltd., Mr. Saint-Smith has been with the Queensland geological survey for the last thirteen years. He received his training in the New South Wales Department of Mines, and prior to going to Queensland was senior field geologist in Western Australia.

George Weir, general manager of the North Broken Hill Co. for the last twenty-three years, will retire at the end of 1926. C. J. Emery, who was manager of the British mine (which is now part of the North's property), has been appointed general superintendent, and W. C. Gall will be in charge of mining operations.

The closing of the United Langi Logan Co. at Ararat, Victoria, marks the termination of deep lode gold mining in Victoria. In the past Ballarat, Maryborough, Stawell, Creswick, Clunes, and Rutherglen were all important deep lode centres, but in recent years Ararat has been the principal centre. One of the most successful properties was the Madam Berry mine, at Creswick, which paid over £1,000,000 in dividends.

The program of development of a deep lode property calls for considerable capital expenditure in sinking through the basalt, for developmental drives, and for the equipment of efficient pumping machinery to drain the lode. Formerly a yield of 15 dwt. per fathom was sufficient to insure profitable operations, but today more than an ounce per fathom is necessary to cover the cost of extraction. Some years ago the Mines Department of Victoria published a valuable memoir on the deep "leads" of Victoria. This shows that there are many promising deposits awaiting development, but when it is stated that in the Ararat district over £500,000 was spent for very little return it will be realized that great faith in the district is necessary on the part of investors.

Blast at United Verde Mine Kills Two Men

WHILE steam shovels were attacking the open workings on the 160 level of the United Verde mine at Jerome, Ariz., recently, the grinding of the steel bucket set off a powder charge. As a result the engineman on the shovel and the tripperman were both instantly killed. A tooth of the huge shovel dipper was hurled through the roof of a hotel, and mine timbers were found nearly a mile from the scene of the blast. Several buildings were damaged and practically all the plate glass in Jerome was broken by the explosion.

As every charge of powder placed is fired and checked off as exploded, before steam shovels are permitted to attack the open workings, the only explanation for the unexpected blast is that a portion of the charge in one drill hole must have failed to explode. This happens not infrequently with low-grade blasting powder.

Gold Telluride at Orogrande

Ralston McCaig has returned to Spokane from an inspection of the Una property, where he is developing a 16-ft. vein, three miles west of Orogrande, in Central Idaho, at a depth of 250 ft. Mr. McCaig reports that the ore contains gold telluride. He says it often has been denied that gold telluride exists in this district, but that its presence has been proved by the Una and this gives credence to the claims of discoveries of similar mineralization in other properties in the same district.

Southwest Oregon Gold Mines May Be Reopened

Considerable importance attaches to the gold-mining industry in southwestern Oregon in the discovery of free gold in telluride ore in the Kubli mine, three miles out from Gold Hill. This is the first free gold ever found in this class of ore in this region, and will be an incentive to reopen other mines in the district, in which there exist occurrences of telluride ores. This orebody appears in a lower workings of the mine on the contact of the oxidized and base zone and runs thousands of dollars in gold per ton. The pay shoot has been uncovered only about 16 ft., but will probably extend 100 ft., judging from work above.

The vein strikes nearly north-south and dips slightly east, between walls of diorite 4 ft. in width, and composed of 2 ft. of quartz found on either wall. The remainder of the vein is made up of gouge containing breccia, slate, serpentine, talc, quartzite, porphyry, and calcite. It has developed that in treating the oxidized ores in this region that have been milled in the past, at least 80 per cent of the gold values were lost in the slimes which passed over the plates and concentrating table and could have been saved by the flotation treatment.

London Letter

By W. A. Doman
Special Correspondent

Central Provinces Manganese Ore Co. Enters Agreement

British Ferro-Alloy Makers Join New Group—Transvaal Platinum Report Not Overly Optimistic

Nov. 23, 1926—Recently Central Provinces Manganese Ore Co. has entered into an arrangement with ferromanganese makers in this country, thus unifying the interests of producers and makers. Central Provinces company controls some twenty manganese mines in the Central Provinces in India, shipping ore through Calcutta and Bombay. The ferromanganese makers undertake to buy all the ore they require from the company, at agreed prices, and the new company which has been formed will act for the benefit of both parties as the marketing agent of ferromanganese. The idea is to place the ferromanganese industry in this country on a profitable basis, and to increase the demand for the high-grade ores of the Central Provinces company. The new company has a capital of £350,000 divided into 50,000 ordinary shares and 300,000 6 per cent preference shares of £1 each. The Central Provinces company and the four principal makers of ferromanganese will go into the business on the basis of fifty-fifty.

A discovery of gold is announced in the Transvaal on the Farm Waaikraal, 25 miles north west of Rustenburg, on the edge of the platinum belt. So far, according to cablegrams, the reef is said to average 27 dwt. over 82 in., some samples giving 6 oz. to the ton. About 1,300 ft. of reef are exposed.

The report of the directors of the Transvaal Platinum is a somewhat discouraging document. The company exhausted its working capital and borrowed £30,000 from the Transvaal Consolidated Land & Exploration Co. and the South African Townships Mining & Finance Corporation. June 30 last £22,800 had been advanced, repayable in March next. Sampling was not borne out by bulk tests, for whereas the recovery was estimated to be 10.6 dwt., actual reduction operations showed only 6.89 dwt. The Welgevonden section cannot keep the mill supplied with sufficient high-grade ore to cover costs, and operations have been suspended. The lenders took a bond over the property for £30,000 at 7 per cent interest, and this is supposed to be fully covered.

Bauxite Deposits in Russia

The expedition sent by the Aluminum Company of America to investigate aluminum deposits in the Soviet Union is now conducting research in the Batum region and the northern Black Sea coast, according to advices received by the Russian Information Bureau of Washington, D. C. The advices state that aluminum ore was discovered in the Gandjinsk district of Azorbaijan.

Societies, Addresses, and Reports

Mining Congress Gets Under Way

Hoover Present on Opening Day—Conditions Surveyed by Representative Men—Politics and Natural Resources Theme of Several Speakers

WASHINGTON, the natural background of the American Mining Congress, as it seems to those who follow mining, was again the setting of the organization's annual convention that opened on Tuesday morning, Dec. 6, of the week just ended. This year the convention shifted its headquarters from the New Willard Hotel, where the twenty-eighth annual meeting was held, to the still newer Mayflower, in which surroundings the affairs of the convention were conducted.

Hugh Shirkie, this year's president, was absent, and H. W. Seaman, a past president, took his place. James F. Callbreath, the vigorous secretary of the Congress, was ever present—indeed his absence would make a noticeable hole in the proceedings. The opening session was almost prompt in starting—which is saying a great deal when one recalls the dilatoriness that marks many meetings of the sort. The opening program was logical in nature: it consisted of a series of résumés, by representative men, of conditions in the various mining industries—gold, lead, silver, zinc, and non-metallics, as well as coal. It was logical because when meeting to discuss how conditions in an industry may be bettered it is proper to tell first what those conditions are.

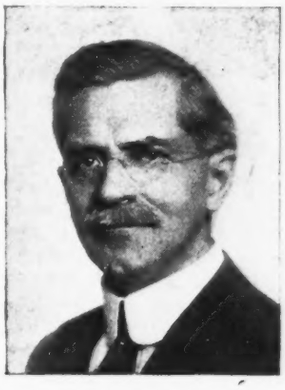
Julian D. Conover, secretary of the Tri-State Zinc and Lead Ore Producers' Association, told of conditions affecting zinc mining. His remarks, together with those of the other speakers at Tuesday's sessions, will be reported at length in next week's issue. He presented many facts and statistics of interest to those concerned with zinc. J. D. Ady, Jr., of Colorado Springs, whose name did not appear on the original program of the Congress, told of the position in which the gold producer found himself and suggested a remedy. He did not think the situation past the hope of remedy, despite the quietus given the gold bonus bill a few years ago. Data bearing on the Portland Gold Mining Co.'s operations that the speaker gave were of decided interest, in view of the scanty news that has been published of Cripple Creek.

Frank M. Smith, director of the Bunker Hill & Sullivan smelter at Kellogg, Idaho, undertook to tell of the situation of lead, and Fred Carroll, formerly State Mine Commissioner had a similar part with respect to silver. H. T. Edgar, of Edgar Brothers Co., limited his discussion of conditions in the non-metallic field that the program promised, to the domestic clay industry, particularly in Georgia and South Carolina.

All of these speakers, save Mr. Ady and Mr. Carroll, stressed the importance of a tariff. Mr. Edgar went a step further and emphasized the important part that freight rates play in deciding whether the clay producer can operate or not.

R. C. Allen, who had been called upon suddenly to tell the convention how conditions were in the Lake Superior iron country, performed this service well, setting forth the salient facts in a striking way. Both branches of the coal industry had spokesmen: Dr. E. W. Parker, for the anthracite operators, and Walter Barnum, of the National Coal Association, for the bituminous companies.

On the program the topic for discussion at Tuesday's afternoon session was "Politics and Natural Resources." The



James F. Callbreath
Secretary American Mining Congress

first speaker, whose name had not previously been announced, was to talk on "The Growing Tendency Towards Centralization of Government in Washington." It proved an interesting surprise when Secretary Hoover made his appearance to discuss this topic. Mr. Hoover's talk was short and to the point. Business was responsible, directly or indirectly, for this tendency toward centralization, the Secretary asserted.

At the recent Denver meeting one of the important topics on the program was that of "Public Lands." On that occasion the principal speakers were Governor Dern of Utah and Representative Charles E. Winter, of Wyoming. Practically the same topic was discussed in Washington, the speakers this time different in person but alike in views. F. W. Mondell, formerly Representative from Wyoming, talked on "Further Disposition and Control of Our Public Lands"; and the Assistant Attorney General of Utah, W. Halvorson Farr, spoke, on behalf of Governor Dern, on "Who Should Control Public Lands Which Contain Minerals."

Judge Nathan B. Williams, of the National Manufacturers' Association, discussed the topic "A Sensible Application of Our Anti-Trust Laws." Following him, the next speaker, talking on "Discovery as Applicable to Oil Shale Lands," spoke interestingly on oil shale, but said nothing about discovery. His speech, however, was evidently intended to voice the objection of oil shale men to the present regulations prescribing that "discovery" can be recognized only where there is an exposure on the surface of shale having an oil content of not less than 15 gal. per ton.

With these addresses the proceedings of the first day ended. One might say that it was quite enough for one day's proceedings. The legal aspects of the afternoon's discussions doubtless made them a trifle heavy for the presumably non-legal mind of the average mining member present. There being no evening session, however, opportunity to relax presented itself before the day was over.

All delegates and members were guests of the Mining Congress at an informal luncheon on this first day of the meeting. An account of the annual banquet, set for Thursday, and of the remaining sessions will appear in full in next week's issue.

Northwestern Association Urges Repeal of Federal Stamp Requirements

The Northwest Mining Association at its last meeting held on Dec. 2 in Spokane passed a resolution requesting the American Mining Congress to urge the repeal of the federal revenue measure under which corporation stamps are required in mining transactions. At the same meeting other action of importance to Northwest mining was taken. A committee was appointed to prepare resolutions urging the Legislature of Washington to provide a good highway through Stevens County from a Spokane connection, to Trail, B. C., where the smelter and refineries of the Consolidated Mining & Smelting Company of Canada are located. The present road is little more than a trail. The distance from Spokane is about 140 miles.

The legislative committee, of which Attorney Joseph McCarthy is chairman, was requested to submit for consideration at the next meeting a bill for a corporate securities act for Washington as a substitute for any proposed "blue-sky" mining laws. Washington is one of the few states of the union which has no such "blue-sky" law for mining, thanks to the continued opposition of the Northwest Mining Association. The association protests against any law which will give a state official the authority to pass on the merits of any mining corporate enterprise or on the merits of mine or prospect, but is willing to have a corporation act which will regulate. The committee will also ask the legislature to cut corporation fees in Washington, which are considered excessive.

The association considered the question of the annual mining convention, which probably will be held in February, but left it to a ballot by mail of the members to determine whether to hold the convention in Spokane, Nelson, Wallace, Kellogg, Seattle, Vancouver, or some other city.

People You Should Know About

H. K. Scott has moved his office to 83 Queen Victoria St., London.

G. A. Gow is with the Chosen Syndicate at Taiyudong, in Korea.

Colonel Arthur S. Dwight has gone abroad, where he will make an extended visit in Egypt.

Arthur W. Jenks has gone to southern Mexico, where he will make an examination of mining property.

Hugh R. Van Wagenen has returned to Los Angeles after completing an examination in the vicinity of Wellington, Nev.

E. B. Kimball, mining engineer, of San Francisco, recently returned from Texas, where he was engaged in petroleum investigations.

T. Skewes Saunders, of Mexico City, has been in New York and Boston on business connected with various mining interests in Mexico.

Walter Douglas, president of Phelps Dodge Corporation, is visiting new construction work at the plants of the corporation in the Southwest.

P. W. Racey, superintendent for the Tonopah Belmont Development Co. in Nevada, has returned to Tonopah from a business trip to Los Angeles.

H. S. Denny, who has opened an office at Toronto in the name of the Mentor Exploration & Development Co., will return to London for Christmas.

John G. Kirchen, general manager of the Tonopah Extension Mining Co. at Tonopah, Nev., has returned to Tonopah from a business trip to New York.

J. E. Spurr and **A. H. Hubbell**, of the staff of *Engineering and Mining Journal*, attended the meeting of the American Mining Congress at Washington, from Dec. 7 to 10.

H. D. Budelman, mine superintendent for the West End Consolidated Mining Co., in Nevada, has returned to Tonopah from a two weeks'. absence in California.

F. W. Bradley has returned to San Francisco from Idaho, but will go north again soon in connection with the completion of the zinc refinery of the Bunker Hill company.

G. L. Sheldon, of Choix, Sinaloa, Mexico, has left for the United States. Mr. Sheldon's address will be United Eastern Mining Co., 1206 Pacific Mutual Building, Los Angeles, for the present.

Don F. Shindler, refinery engineer with the Southwestern Engineering Corporation, of Los Angeles, is making an extended trip through Idaho, Montana, and up into Alberta, Canada.

Charles W. Goodale, for many years in charge of the Boston & Montana department of the Anaconda Copper Mining Co., who had been sojourning in Boston and other Eastern cities, has returned to Butte.

A. A. Brown has been appointed superintendent of the Parral unit for the Asarco Mining Co., (A. S. & R.) and **D. J. Pope**, assistant superintendent. **Dan Boyle**, formerly with the El Oro Mining & Railway Co., is now with the Charcas Unit of the A. S. & R. Co.

Charles Mullins, lately stationed on the West Rand, has been appointed Chief Inspector of Machinery for the Union of South Africa. He was entertained to dinner, recently, in Johannesburg, by engineers on the various mines of the West Rand area.

Albert H. Fay

Albert H. Fay, assistant editor of *Engineering and Mining Journal*, is on a field trip through the Alabama iron region and the districts contiguous to Cartersville, Ga., and Ducktown, Tenn.

A. H. Burroughs, Jr., president and manager of the Talache Mines, Inc., Talache, Idaho, recently spent several weeks in New York, and is now in San Luis Potosi, Mexico. While in Mexico Mr. Burroughs will visit Mexico City. He expects to return to the United States before the end of this month.

Hans Lundberg, a Swedish engineer whose electrical process for indicating ore at depth was adopted with marked success on the Horne property, is engaged on the Amulet, in the Rouyn area of Quebec. His services are in great demand among mine owners, whose requirements will keep him busy for some time.

Charles A. Mitke is in Washington, D. C., where he is appearing before Secretary Work of the Department of the Interior, on behalf of the oil-shale interests of Colorado in their application for a new mineral law covering the location of such deposits. The question involves the application of caving methods to oil shale, and Mr. Mitke will discuss this feature of the case.

S. F. Shaw has resigned as general manager of the Cia Mra. Nazareno y Catasillas, Salaverna, Zacatecas, Mexico, and will devote most of his time to developing the use of air and gas lifts in oil wells. He is making investigations in various Gulf Coastal fields, and during December and January will be in Seminole, Okla., for the Carter Oil Co., a subsidiary of the Standard Oil Co. of New Jersey.

M. L. Baillieu, son of G. Baillieu, well known as identified with mining concerns in Australia, has returned to Melbourne from England, under engagement to the Electrolytic Zinc Co. of Australasia, to inspect and advise on the layout of the acid plant of that corporation's large ore treatment works at Port Pirie, South Australia. The junior Mr. Baillieu graduated at Cambridge about two years ago and joined the technical staff of the National Smelting Co. at Avonmouth, England, and went to Port Pirie by arrangement with his English employers.

S. N. Graham, professor of mining at Queen's University, Kingston, Canada, has been granted a month's leave of absence so that he may be afforded an opportunity to go to England on professional business. **Douglas G. H. Wright**, chief geologist and exploration engineer for Dome Mines, Ltd., has been granted a temporary leave of absence so that he may assume the duties of professor in mining engineering at Queen's University during Professor Graham's absence in England.

Obituary

Edward S. Hawkins, camp superintendent at the Dome Mines, of South Porcupine, Ont., died at Timmins on Nov. 29. Mr. Hawkins was thirty-two years of age.

George U. Young, at one time Secretary of the Territory of Arizona, owner of the Derby mine, near Prescott, and president of a company owning a promising gold property at Youngsberg, some 50 miles east of Phoenix, died suddenly on Nov. 24. The body lay in state in the rotunda of the capitol building from ten o'clock until noon, the day of the funeral, so that the many who knew him might pay final tribute. At one time Mr. Young was Mayor of Phoenix and was also a candidate for Governor. He was active in the building of the Grand Canyon Railroad and took part in many other enterprises, but he was principally interested in mining.

Walter Karri-Davies died at the age of fifty-nine in London on Nov. 28. An Australian by birth, he spent most of his active career in South Africa, where he engaged profitably in the karri lumber trade. During the South African War he distinguished himself greatly, but declined both promotion and other honors. With Wools Sampson he raised the Imperial Light Horse, serving as major. At the outbreak of the Great War he offered his services to Lord Kitchener, but injuries received during his former campaigns unfitted him for active service, so he became British Provost Marshal, with the rank of colonel, at San Francisco, where he was living at that time, and where he made many friends. "Karri" will be mourned by hundreds in many lands, in many services and professions, military, mining, and commercial. A big stalwart man, of heroic mold, with a heart as big as his chest, kind, intelligent, courteous, lovable, he leaves a memory that will long be cherished. To his devoted wife and children will go the deepest sympathy in their sudden bereavement. T. A. R.

Recent Technical Publications

Reviews, Abstracts, and References

Industrial Relations

The New Leadership in Industry. By Sam A. Lewisohn. E. P. Dutton & Co., New York. Price $2.

Mr. Lewisohn subjects the labor problem to what he considers to be a rational analysis, uncolored by the emotions. This writer might be expected to be capitalistic in his views. In fact, he starts out by defending capitalism against some of its critics. He says that it is a profound error to approach labor unrest as if it were mainly due to the peculiar defects of capitalism. But one quickly becomes convinced of his honest-mindedness and his intent to discuss the subject in a non-partisan way. Die-hards will have fault to find with some of his opinions. Mr. Lewisohn, it should be explained, is vice-president of the Miami Copper Co. An impartial attitude, moreover, becomes him in his additional rôle as chairman of the board of The American Management Association.

Inasmuch as employers—those capitalists who have real contacts with laboring men—pride themselves upon being the responsible class and resent any interference, Mr. Lewisohn argues, they should strive as hard to secure results in human relationships as they do in production, sales, finance or research. This should lead to a new fashion in leadership.

His argument brings him quickly to the need for educating managers. Catch them young, he counsels, as then they are easier to train than later when they may have become hard-boiled. He emphasizes the increasing importance of engineers as industrial executives and asserts that, although the management of labor relations is largely in their hands, they are generally unprepared to administer these relations. A narrow technical education, limited to the quantitative sciences, does not help a man to assume the leadership of men, he says. The training of the engineer solely in the reactions of dead matter has tended to cripple his native capacity in handling human relations. The remedy for this must be put up to engineering educators.

The greater problem remains of liberalizing the attitude of that large group of managers who rise from the ranks without previous training. For these he points to the national associations that serve as clearing houses for modern management methods, such as his own association and the Taylor Society. Also, there are local organizations as well as the government in its regulatory capacity.

Employee representation as an aid to management receives due attention from the author. This, he says, has the principle of consultation for its basis. Its aim is a compromise between the self-determination of the political field and the executive responsibility essential to the proper form of the productive system. But there must also be a compromise between freedom and authority. Employee participation may be useful in mitigating aggressiveness natural to leadership, but it may go too far in curbing the initiative and responsibility that are necessary in securing results.

In discussing unionism, Mr. Lewisohn says: "An employer who is in an industry in which unions are well-seasoned and well led, and show evidence of constructive possibilities, accepts the *status quo*. He endeavors to ascertain what elements of social and industrial usefulness they contain. He may find this type of union a valuable agency for securing group co-operation. If it is a matter of bargaining, he does not show any more emotion, asperity, or impatience than he would in bargaining with a business equal. He then goes further. He not only makes terms with such unions but regards it as part of his responsibility to develop constructive methods of co-operation with them. He regards it as a real opportunity in social experimentation. This attitude is rare, but it should become the rule. To make use of the union in improving daily employment relationships, where it is possible to do so, is part of constructive leadership."

As for wage policies, Mr. Lewisohn concludes: "Employers who approach this problem from a broad perspective should realize that driving a hard bargain with labor at all times may be the inheritance of erroneous wage theories of the past. They should also be alive to the fact that these theories were probably rationalizations of unreasoning attitudes. They should therefore not allow themselves to be bound by such traditional points of view." Niggardliness should be avoided in the matter of general wage policies, he says; likewise, general wage inflation during boom periods, which is apt to be disastrous.

Summarizing, the author says: "Unsatisfactory labor relations may exist where there is no absentee ownership, no large-scale industry, and complete union recognition." On the other hand, he asserts: "Bad conditions practically never exist where there is a modern management, even when absentee ownership, large-scale industry, and lack of union recognition are present. There is no escaping the conclusion that the most important factor in sound industrial relations is management."

A. H. HUBBELL.

Coley Process—What is perhaps the most complete description of the Coley process of zinc smelting that has so far been published appears in the Nov. 13 issue of *The Ironmonger* (42 Cannon St., London, E. C. 4; price 9d.), pp. 2. In this process a liquid hydrocarbon is used for reduction, being sprayed on to the heated zinc-bearing charge in a rotating tube. The process is also described in *The Mining Journal* (London; price 8s.) for Oct. 30, 1926, in a short article.

The Formation of Petroleum

The Geology of Oil, Oil Shale, and Coal. By Dr. Murray Stuart. Mining Publications, Ltd., London. Price, 7s. 6d.

This little book has few pages, yet cannot be carelessly skimmed through; it is one of those which merit a second and a third reading. It is a scholarly essay on the origin of oil, oil shale, and coal.

The author excludes inorganic sources for petroleum in the beginning, holding that the optically active behavior of natural petroleums in polarized light is that characteristic of substances having organic origin. In pursuing his investigations the author first takes up the deposition of oil as a sediment (Chapter II), holds that the oil in some sedimentary rocks, especially those lacking in fossil remains, is not derived from the conversion of organic matter, but is deposited as oil; and that similar deposition of the spores of plants would give rise to oil shale. Chapter III treats of the origin of coal. Referring to the older theory of the origin of coal by the submergence of forests which in the course of time became changed to coal, the author observes that this explanation may apply to some deposits but not to others; and cites Juke's theory of 1858 that coal is a geological sediment. It has been found that much if not most coal has been deposited in marine, not fresh-water, basins. Bacteria are responsible for the conversion of sedimentary vegetable matter into coal in fresh water; during earth movements, these fresh-water accumulations are carried to the sea as black, carbonaceous mud, and so accumulate into strata. Chapter IV treats of The Limestone Oils. Oil is found in many regions in dolomitized limestone. These are frequently highly foraminiferal. Such rocks appear to have accumulated in salt lagoons, where animal organisms disappear from the bottom, but sulphur-making bacteria thrive, while in the upper layers of the water, microorganisms like foraminifera abounded. The action of the sulphur-making bacteria would transform the protoplasm of these organisms to petroleum, on the bottom. Unless the bottom waters were thus stale and deprived of oxygen, petroleum would not be formed.

Chapter V treats of the Oil in Detrital Sedimentary Rocks. The bluish color of most marine sediment is due to iron disulphide in minute subdivision. The conversion into this of the assumed original iron oxides of the detritus is attributed to the sulphur-making bacteria of the sea water. Fresh-water sediments, on the other hand, have usually a brownish or reddish color. If these bacteria were present any protoplasm might be converted to petroleum, and large amounts of contributed protoplasm would mean abundant oil formation. A stagnant condition, to eliminate bottom-thriving predatory organisms, appears an essential postulate. Vegetable oils may be converted by the same sulphur-making bacteria into saturated hydrocarbons. The composition of an oil (petroleum) would depend partly upon the conditions under which the strata were deposited, partly upon the type of vegetable oils originally

contributed. Since the bacteria thrive only in salt water the suggested transformation of vegetable oils into saturated hydrocarbons would not take place in fresh water. The blue color of unoxidized oil-field strata of marine origin testifies to the action of these bacteria, in contrast to which are the drab colors of oil shale developed under brackish or fresh-water conditions, and these oil shales yield unsaturated hydrocarbon. Therefore, the lateral variations of coal seams, as in the Carboniferous of Great Britain, are found to be into oil shale.

Gypsum in connection with petroleum strata does not necessarily mean deposition in basins of desiccation. The gypsum may be secondary, due to the action of meteoric waters on the iron sulphide in the strata.

Chapter VI treats of the relationship of fossil wood to oil. It is maintained that the vegetable oils originally in fossil wood may be carried down, and form a petroliferous layer.

Chapter VII treats of the Oil Produced by the Dynamo-Metamorphism of Coal Seams. An overthrust fault zone in Burma is taken as an example; along this, petroleum occurs. The fault traverses beds containing seams of high-volatile coal; where the coal has been involved in the faulting it has in places lost much of its volatile matter, and occasionally approximates anthracite. This expressed volatile matter has been transformed into oil and gas.

The author finally deduces (p. 91) from the above argued principles, certain guides for occurrence and exploration of petroleum and oil shale.

J. E. SPURR.

Safety Calendar—The National Safety Council has published an attractive large calendar for 1927, single copies of which are 50c., ranging down to 22c. each for large quantities. The address of the Council is 108 East Ohio St., Chicago.

Illinois Petroleum — Press Bulletin, Series No. 4, entitled "Illinois Petroleum," was recently issued by the State Geological Survey, Urbana, Ill., from which it is obtainable for 10c. Areas in Clark County and the Centralia district are discussed.

New Patents

Electrolytic Refining

Nos. 1,607,869-70. Nov. 23, 1926. F. F. Colcord, New York, assignor to U. S. Smelting, Refining & Mining Co., Portland, Maine. No. 1,607,869 covers the use of sulphite lignose as an addition reagent in the electrodeposition of zinc with sulphuric acid electrolytes. No. 1,607,870 covers the use of soluble hydroxy derivatives of benzol in the same connection.

No. 1,607,960. Nov. 23, 1926. C. P. Madsen, New York, assignor to Madsenell Corporation, New York. The electrodeposition of nickel metals by using a nickel metal electrodeposition bath containing an iron compound, with none of the iron in the ferric condition, thus preventing the formation of pits in the deposited metal.

No. 1,607,994. Nov. 23, 1926. C. P. Madsen, New York City, assignor to Madsenell Corporation, New York. In the electrodeposition of nickel, chlorine is used to oxidize organic matter present in the bath.

No. 1,608,706. Nov. 30, 1926. C. P. Madsen, New York City, assignor to Madsenell Corporation, New York. In the electrodeposition of nickel, the use of a salt of nickel in solution, and a finely divided hydrate of nickel in suspension therein.

Grinding Machinery

No. 1,606,545. Nov. 9, 1926. P. E. Van Saun, Jersey City, N. J., assignor to J. E. Kennedy, New York. A screen partition for tube mills, consisting of a perforated plate.

No. 1,607,858. Nov. 23, 1926. J. A. Acker, Port Huron, Mich., assignor to Traylor Engineering & Manufacturing Co., Allentown, Pa. Design and arrangement of a series of grate bars within a ball or tube mill.

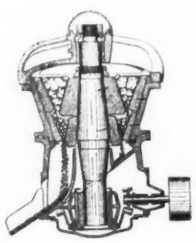
No. 1,607,842. Nov. 23, 1926. R. C. Newhouse, Chicago, assignor to Allis-Chalmers Manufacturing Co., Milwaukee. A spiral screw feeder, mounted in a trunnion.

Crushing Machinery

No. 1,605,969. Nov. 9, 1926. B. A. Mitchell, New York. A crusher of the gyratory type.

No. 1,606,114. Nov. 9, 1926. W. S. Weston, Columbia, S. C. Design for a gyratory crusher.

No. 1,607,615. Nov. 23, 1926. R. C. Greenfield, Milwaukee, assignor to Allis - Chalmers Manufacturing Co., Milwaukee. A gyratory crusher with a pair of adjoining crusher heads, as shown in the accompanying illustration.



No. 1,607,649. Nov. 23, 1926. J. M. Sholl, Milwaukee, assignor to Allis-Chalmers Manufacturing Co., Milwaukee. Design of a frame for a gyratory crusher.

No. 1,607,843. Nov. 23, 1926. R. C. Newhouse, Chicago, assignor to Allis-Chalmers Manufacturing Co., Milwaukee. A method of eliminating vibration in crushing machines, by the use of revolving weights.

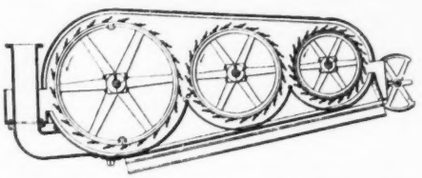
Xanthate Manufacture—Reissue No. 16,474. Nov. 16, 1926. Ludwig Rosenstein, San Francisco, assignor to Great Western Electro-Chemical Co. Alkali metal xanthates are produced by dissolving an alkali metal hydroxide in water, adding ethyl alcohol, cooling the mixture, and adding carbon bisulphide.

Flotation Machine—No. 1,608,896. Nov. 30, 1926. J. C. MacIntosh, Douglas, Ariz., assignor to The General Engineering Co., Salt Lake City. This patent covers the MacIntosh flotation machine, in which the air is admitted into a hollow horizontal rotor covered with canvas or other porous medium, through which the air escapes into the pulp. The machine is now on the market.

Rock-Drill Valve—No. 1,606,835. Nov. 16, 1926. C. C. Hansen, Easton, Pa., assignor to Ingersoll-Rand Co., Jersey City, N. J. Design of a valve for a rock drill.

Flotation-Amalgamation—No. 1,606,249. Nov. 9, 1926. Paul Kuehn, Denver. Precious metals are recovered from low-grade ores by agitating the finely ground pulp in the presence of soapy water and a current of air, the concentrate then being brought into contact with mercury.

Classifier—No. 1,607,490. Nov. 16, 1926. W. H. Taylor, Warren, Ariz. An ore classifier of the type shown in the accompanying illustration.



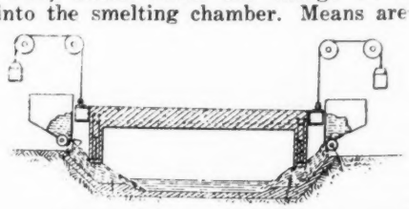
Volatilization—No. 1,606,343. Nov. 9, 1926. C. L. Burdick, New York, assignor to Guggenheim Bros., New York. A method of forming volatile sulphur compounds of metals, in the presence of a reducing gas, and condensing the product, thus recovering the desired metal.

Vibrating Screen—No. 1,606,558. Nov. 9, 1926. Henry Clark, Westminster, London, assignor of one-half to Head Wrightson & Co., Ltd., Thornaby-on-Tees, England. A vibratory screen actuated by a reciprocating engine.

Float Gold—No. 1,607,845. Nov. 23, 1926. J. E. Parker, Woodford, Okla. A viscous hydrocarbonaceous mass is spread on to rigid combustible supports and the whole placed in a stream of running water containing particles of flour gold or other fine minerals. The gold is supposed to stick and coalesce to the mass, and after a sufficient amount has accumulated, the supports are removed and the whole burned, the valuable metals being recovered in the ash.

Metallurgy of Zinc—No. 1,608,358. Nov. 23, 1926. E. S. Berglund, Djursholm, Sweden. A stirring device in connection with a condenser, whereby zinc powder is violently agitated and converted into fluid zinc.

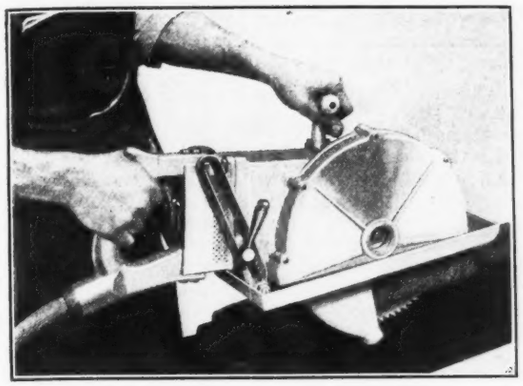
Smelting Furnace — No. 1,608,557. Nov. 30, 1926. J. C. Greenway, Ajo, Ariz.; Isabella Greenway, and L. D. Ricketts, executors. A reverberatory furnace with a roof and hanging sidewalls, under which the charge flows into the smelting chamber. Means are



provided for raising and lowering roof and sidewalls, the idea being made clear in the accompanying cut.

Leaching—No. 1,608,844. Nov. 30, 1926. G. W. Edwards and H. T. Durant, London. Oxidized ores are leached with an excess of an aqueous solution of an ammonium salt containing an excess of free ammonia, the charge being stirred and maintained at a temperature only slightly below the temperature at which the ammonium salt commences to dissociate and the dissolved metal commences to be precipitated.

New Machinery and Inventions



This portable hand saw is motor-driven

Portable Electric Hand Saw Announced

The portable electric hand saw shown in the accompanying illustration is being manufactured by the Wappat Gear Works, Meade St. at Braddock Ave., Pittsburgh, Pa. It is for use in sawing lumber on construction jobs and in industrial plants. It is equipped with a powerful universal motor for use on either direct or alternating current and crosscuts and rips boards up to and including 3 in. in thickness. Special saw blades can be furnished for cutting wood, fibre, bakelite, hard rubber, stone, steel, and many other materials.

Five saw blades are furnished unless otherwise specified: two 8-in. combination saws, marked No. 1, for crosscutting and occasional ripping; one 9-in. combination saw, marked No. 2, for the same purpose; one 8-in. ripsaw, marked No. 3, and one 9-in. ripsaw, marked No. 4. The motor is rated at ¾ hp. and is mounted upon Timken tapered roller bearings, as is the worm-gear drive to the saw spindle. Regular equipment includes 15 ft. of heavy-duty rubber-covered wire and an armored separable attachment plug.

A particular feature of this device is a telescoping guard that completely incloses the blade and automatically opens only when the saw is pushed into the material. It closes again as soon as the cut is completed. This guard affords maximum safety against accident and protects the blade from damage as well. A wide carrying shoe supports the weight of the tool and prevents tipping, so that the chief effort of the operator is in guiding the saw. This shoe is made of pressed steel and is nickel plated. It is adjustable so that it is possible to set the saw for any depth of cut such as would be required when cutting out sections of flooring and the like. The presence of this shoe insures square cuts and prevents straining the saw blade, thus eliminating the danger of broken blades.

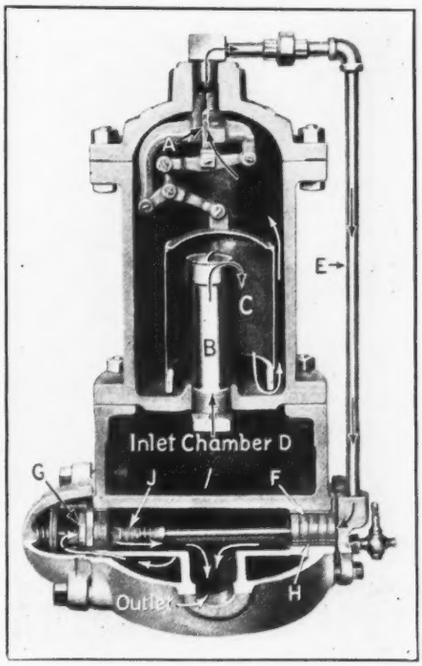
A blast of air from the motor ventilating fan is directed to the front of the saw to blow the sawdust away. The handles of the device are placed to give good balance and to eliminate wrist strain. The total weight of the outfit is 31 lb.

New Armstrong Trap of Large Capacity

To meet the demand for a trap that would handle sudden large inflows of condensate, the Armstrong Machine Works, Three Rivers, Mich., has brought out the compound valve trap illustrated.

The new trap, according to *Power*, incorporates the inverted submerged bucket principle used on the line made for some years by this company and in addition a piston-actuated valve in the base of the trap allows large quantities of water to be discharged rapidly.

The operation of the trap is as follows: Assume that the upper part of the trap, with the exception of the inverted bucket, is full of water. The bucket, full of steam, is afloat, holding the valve *A* closed. As long as the steam flows into the trap and up through tube *B*, replacing what condenses, the bucket continues afloat and valve *A* remains closed.



Meets sudden large inflows

The piston-operated valve gives this trap adequate capacity, enabling it to discharge large quantities of water rapidly.

Water accumulates in the base or chamber *D* until the bottom of tube *B* is submerged and further flow of steam into the bucket *C* is stopped. Steam in the bucket condenses; the bucket loses its buoyancy and sinks; and as it sinks the valve *A* is drawn open. The discharge which then takes place through valve *A* and pipe *E* builds up a pressure behind the piston *F*, which moves away, opening valve *G*. The opening of this valve releases water from the inlet and base of the trap, and direct discharge takes place through valve *G*, as shown by the arrows.

When the discharge lowers the level in the base until the bottom of the tube *B* is uncovered, steam again flows into the bucket and buoys it up. As the bucket rises, it closes the valve *A*, stopping the discharge through the pipe *E*. When valve *A* closes, the pressure in the cylinder and against the piston *F* is dissipated through the vent *H* in the piston *F*. When this takes place, the flow of water through the valve *C*, together with the spring *J*, causes the valve *G* to close and the cycle of operation is completed. The trap continues to discharge as long as water comes to it, and if the flow is small the water may be handled entirely through the valve *A* and vent *H*. The cap, body and base castings are of cast iron, and the upper valve *A* and the piston valve parts are of heat-treated chrome steel.

Hot Dust Handling Problem Solved by Spray System

The Southern Cement Co., of Birmingham, Ala., has recently started to operate a dust-collecting system which, it is claimed, completely solves the problem, and at the same time gives an exceptionally high recovery. The principal difficulty encountered was the high temperature of the dust and gases from the drier. This made it impossible to cleanse the air by utilizing directly the high efficiency of a dust arrester of the cloth screen or air filter types.

The hot dust and gases from the drier were therefore first passed through a separator (which type is not affected by the heat, and which recovers about 60 per cent of the total dust). The remaining 40 per cent passes into a steel tank, in which it is mixed with finely atomized spray and precipitated in the form of sludge.

Although this system necessitates an extra operation, it permits the recovery of over 99 per cent of the material, as compared with the much lower percentage which a plain cyclone collector would allow; and this much more than offsets the slightly higher operating cost. The entire equipment was installed by Northern Blower Co., Cleveland, Ohio.

Refractories — A bulletin entitled "Hytempite in the Power Plant" has been issued by the Quigley Furnace Specialties Co., 26 Cortlandt St., New York. It describes some of the applications of Hytempite in refractory construction and maintenance.

Market and Financial News

Utah Apex Reports Decrease in Net Profits

Lower Grade of Ore and Decreased Production Affected Earnings in Last Fiscal Year

The Utah Apex Mining Co. earned a net profit, after depreciation but before depletion charges and federal income taxes, of $781,986 for the fiscal year ended Aug. 31, 1926, compared to $1,054,762 for the preceding fiscal year. This is equivalent to $1.48 a share on the 528,200 shares of stock, compared with $1.99 for the 1925 period.

Production amounted to 35,310,657 lb. of lead, 15,377,216 lb. of zinc, 5,706,995 lb. of copper, and 822,737 oz. of silver; compared to 45,828,820 lb. of lead, 19,384,081 lb. of zinc, 3,989,981 lb. of copper, and 906,189 oz. silver in the preceding year.

Current assets on Aug. 31, 1926, amounted to $1,285,134, including $69,838 in cash and $1,059,797 in Liberty bonds and treasury notes. Current liabilities were $239,892. Working capital totaled $1,045,242. The sum of $686,640 was paid in dividends during the year. Lower grade of ore and lower production were the principal causes of the decrease in earnings. The recent decrease in the prices of silver and lead caused a decreased return of $30,000 per month on the current production.

Additions were made to the mill, which give it a total crushing capacity of 1,000 tons daily, and a fine-grinding and flotation capacity of 750 tons, divided into 300 tons of lead-zinc and 450 tons of lead-copper ore. The increase in zinc and copper production is expected greatly to enhance the company's revenues. From Aug. 31 to the last of November, as a result of mill improvements, zinc output amounted to 8,312,673 lb. of zinc in the form of concentrate.

Bingham Mines Co. earned for October, after taxes but before depreciation and depletion charges, approximately $18,000, comparing with $25,435 in September. For the first nine months this year net profit after taxes was $185,444, or $3.71 a share, on the 50,000 shares of stock outstanding.

Vipond Consolidated shareholders, at a special meeting held in Toronto on Nov. 25, ratified the taking over of the British Porcupine Mines. Dr. J. McIntosh Bell explained that the Porcupine Crown vein dips into the Vipond and that extensions of the Vipond vein system continued into the property of the British Porcupine, so that the acquisition of that property for a consideration of 250,000 shares of the Vipond was clearly advantageous. As regards the operations of the Vipond, Dr. Bell stated that in the last few months costs had been reduced from $7.60 to $5.55 per ton.

The Norwegian aluminum industry, which is based upon the country's abundant supply of cheap hydro-electric power, has been developed during the last twenty years, largely, at least, by foreign interests and capital, says a report from the U. S. Department of Commerce. Two plants belonging to a British company now produce more than 3,000 tons per annum, and upon completion of contemplated extensions will exceed 4,000 tons; French interests produce about 15,000 tons and American capital has also entered the field. Since the war various extensions have been planned, and when additions now contemplated at Kinsarvik and Glomfjord are completed it is estimated that Norwegian production will be increased from approximately 25,000 tons per year to about 65,000.

Tintic Standard's Earnings Improve This Year

The Tintic Standard Mining Co. will pay a dividend of 20c. a share on Dec. 23, and one of 30c. a share on Jan. 3, to stockholders of record Dec. 11. Earnings of the company for the first nine months of 1926 display a marked improvement, notwithstanding lower metal prices. Net operating income for the first nine months of the year amounted to $2,114,856, compared with $2,010,268 for the same period of last year. Non-operating income for the first nine months of the year amounted to $176,745, compared to $126,463 for last year. Liquid assets of the company total a sum in excess of $4,000,000.

Silver production for the year up to Oct. 1 aggregated 2,681,788 oz., compared with 2,658,773 oz. last year. Lead production for the same periods: 30,374,740 lb., compared with 28,332,410 lb. in 1925.

Alaska Juneau Gold Mining Co. reported gross income for October of $187,000, against $202,000 in October, 1925. The deficit after interest and capital expenditures was $23,250 against surplus of $9,950 after capital expenditures in October last year. However, changes in the mill are now 95 per cent completed, and preparatory work on the Ebner property is done, although additional prospecting work which has been started will be carried on. This should reduce the expenditures for capital account hereafter.

Aluminum production in Germany is being increased progressively since the Inn Werke, at Toeging, in Bavaria, went into operation last year. It is expected that 1926 production of raw aluminum will amount to from 20,000 to 25,000 metric tons. The German aluminum works were formerly operated by electrical energy derived from lignite, or brown coal, exclusively; but at present about 40 per cent of the power is hydro-electric.

Present Price Level to Last Till 1930; May Then Recede

In its weekly letter dated Nov. 27, 1926, the "Harvard Economic Service" discusses future commodity prices in some detail. This organization continues to believe that until 1930 prices will fluctuate around a level approximately 50 per cent above the 1913 level (the index for the week ending Nov. 24 was 43.7 per cent above the 1913 level).

In the next decade, however, certain recent developments have a bearing. One of these is the report of the Indian Currency Commission. This, according to the "Service," does not indicate that any gold borrowing will be necessary on the part of India. "Consequently, there appears to be no menace to the [general commodity] price level in the recommendations of the commission, and, unless something quite different from the commission's program be enacted when the Indian Legislative Assembly takes up the matter early next year, fear from this quarter seems ungrounded."

Probable diminished gold production after 1930 may have more of an effect and lead to a downward trend of world prices, it is held. Increasing demands are expected from the arts, and a diminished production from the mines, especially in South Africa, which may or may not be offset by new discoveries and by improvements in methods of extraction. On the other hand, further economies in the use of gold as reserves may be introduced. "Thus, although we are confronted with the possibility of a downward trend of world prices some time after 1930, it is yet too early to reach a definite conclusion."

The Ahumada Lead Co. reports for the nine months ended Sept. 30, 1926, net income of $827,617 after depreciation, taxes, and other charges, equivalent to 69c. a share (par $1) earned on 1,192,018 shares of stock. This compares with $1,260,232, or $1.05 a share, in the same period of 1925. Net income for the third quarter of 1926 was $230,094 after the above charges, equal to 19c. a share, comparing with $233,686, or 19c. a share, in the preceding quarter, and $497,503, or 41c. a share, in the third quarter of 1925.

Lake Shore Mines, of Kirkland Lake, has declared the expected 10 per cent bonus, in addition to the regular quarterly dividend of 10 per cent. This dividend is payable Dec. 15, to shareholders of record Dec. 1.

Transvaal gold output increased in October, but did not quite reach the July production, which was the highest in years. Recent figures, in fine ounces of gold, follow: July, 860,124; August, 843,854; September, 839,939; and October, 853,296. The total for the first ten months of the year was 8,286,419 oz., compared with 8,020,614 oz. in the same period of 1925.

The Market Report

Avalanche of Copper Orders Turns Prices Up

All Classes of Consumers Enter the Market—Zinc and Lead, However, Quieter Than Last Week—Silver Unchanged

New York, Dec. 8, 1926—Out of a clear sky last Friday morning, soon after 9 o'clock, copper buyers, who had been hibernating for several weeks, entered the market in a body, and the total sales for the next four business days probably set a record for recent years. In the week ending today more copper has been sold than for the preceding six weeks put together and the price has advanced. The other metals did not share in this business, however, both lead and zinc being remarkably quiet, even more so than last week, and at slightly declining prices. The demand for spot tin is also somewhat less. Silver is quiet and substantially unchanged.

Copper Back to 13⅝c., Delivered

Copper was easily available at a new low price of 13¼c. for Eastern deliveries last Thursday, but not a great deal of interest was taken in the market. The next day, the leading wire mills evidently made up their minds that the price had reached such a level that their long-held-up buying was advisable, and they entered the market at the opening of business, and for liberal tonnages. Sellers, seeing the mounting volume of business, notified their customers that the time to buy had apparently arrived, and all classes of buyers placed their orders, from the small brass foundry that wanted only a minimum carload, up. The same price was apparently quoted by every one—13½c. for all deliveries at near-by New England points, and 13⅝c. in the Middle West. Saturday was another big day, considering the half holiday, and heavy buying also took place on Monday and Tuesday. Yesterday, however, sellers began marking up their prices, first to 13.575c., and then to 13⅝c., delivered Valley points, and 13¾c. in the Middle West. These three levels also obtained today. The increased prices, and the enormous tonnage sold in the preceding days, reduced the volume of orders somewhat, but today's business has been fair and winds up the best week in well over a year.

The largest volume of orders has been for January shipment, but thousands of tons have been sold also for prompt and December shipment. February has been well represented, but few orders have been placed for March. The Middle West as well as the East has bought heavily. Fears are expressed that the tonnage placed this week will mean practically no more business until after the New Year, but not all agree on this point, it being argued that the current buying wave only makes up for the deferred buying of recent weeks, and that a considerable tonnage for January and much of the February requirements remain to be purchased. Unless the price is unduly advanced, it is felt that buying should continue on a good scale until interrupted by the holidays. Certainly the advance so far made—of only an eighth of a cent—is exceedingly modest, compared with the volume of business that has been done. It is of interest to note that four sellers did practically nothing at all in the last week, not being satisfied with present prices.

The wire and brass mills report a healthy increase in their orders since the copper market has shown signs of strengthening.

Foreign business was quiet until the last day or two, when reports of higher prices in the United States led European buyers to place a good volume of orders, it evidently being felt that the price decline had been halted and even higher prices might be in prospect. The export association's level has continued all week at 13.95c., c.i.f. Hamburg and Havre, and it seems unlikely that a change will be made unless a further advance is made in the domestic market.

Lead at 7.90c., New York

The lead market has been quieter than last week, both in the East and Middle West, though one large order was booked yesterday. Consumers are still buying only from hand to mouth, practically all of the sales being for prompt or December shipment. Corroding lead seems to be in better demand than some other grades. On Monday, the American Smelting & Refining Co. reduced its contract price from 8 to 7.90c., New York, some lead having been sold at the lower figure as early as last Wednesday. Other sellers, in general, obtained the Smelting company's quotation for such lead as they sold. In the Middle West, prices have declined to 7.70c., without

Daily Prices of Metals

Dec.	Copper N. Y. net refinery	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
2	13.275	68.00	70.75	8.00	7.75@7.80	7.05@7.075
3	13.275	68.00	70.50	8.00	7.75@7.80	7.00@7.05
4	13.275	68.00	70.50	8.00	7.75@7.80	7.00@7.05
6	13.275	68.00	70.00	7.90	7.75@7.80	7.00
7	13.35	67.75	69.50	7.90	7.70@7.75	7.00
8	13.375	67.25	69.375	7.90	7.70	7.00
Av.	13.304	67.833	70.104	7.950	7.754	7.019

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Dec.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
2	56 5/8	57 3/8	64	313 1/2	298 3/4	28 5/8	29	33 1/8	33 1/16
3	56 5/8	57 3/8	64	314 1/4	299 1/2	28 3/4	29 3/16	33 1/16	33 1/16
6	57	57 3/4	64	313 3/4	299 1/2	28 3/4	29 3/16	33 1/8	33 1/8
7	57 3/8	58 1/8	64 1/4	310 1/4	298 3/4	28 5/8	29 1/16	32 15/16	33
8	57 3/8	58 1/8	64 1/4	309 1/4	298 3/4	28 3/4	29 3/16	32 13/16	32 7/8

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Dec.	Sterling Exchange "Checks"	Silver		Gold London	Dec.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
2	4.84 1/2	53 1/8	24 9/16	84s11½d	6	4.84 3/8	52 7/8	24 3/8	84s11½d
3	4.84 1/2	53 1/8	24 3/8	84s11½d	7	4.84 1/2	53 1/8	24 5/8	84s10½d
4	4.84 1/2	52 5/8	24 9/16	....	8	4.84 3/8	53 1/8	24 9/16	84s11½d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

any great pressure to sell, though plenty of lead seems to be available.

Zinc Down to 7c.

The demand for zinc has been almost non-existent during the last week, but it is hoped that the demand for brass making may be stimulated by recent happenings in the copper market. Prices have declined to 7c., St. Louis, but nothing under this has been reported so far. High-grade continues at 9@9½c., delivered in the East.

Spot Tin Below 70c.

The demand for spot tin has lessened materially, and the premium has declined, so that the differential between spot and February is now only about 2½c. Spot Straits today has sold for as low as 69¾c. Prompt supplies of 99 per cent grade are also more easily available.

Foreign Exchange

Closing cable quotations on Tuesday, Dec. 7, were as follows: francs, 3.8375c.; lire, 4.2725c.; and marks, 23.78c. Canadian dollars, $\frac{1}{8}$ per cent discount.

Silver Quiet But Steady

During the last week the Indian bazaars and China have both bought and sold silver, which has given the market an uncertain tendency, but London is now quoting the same price for spot and forward, the discount on future deliveries having disappeared. With the exception of Dec. 4, the New York market has ruled higher than London bids, which fact is accounted for by the placing of orders by India locally rather than through London. Business, however, is on a small scale and the market is quiet.

Mexican Dollars (Old Mexican pesos) —Dec. 2d and 3d, 40¼c; 4th and 6th, 40⅛c.; 7th and 8th, 40¼c.

Other Metals

Quotations cover large wholesale lots unless otherwise specified. London prices are according to latest mail advices.

Aluminum—Both 98 and 99 per cent grades quoted at 27c. per lb. London, £104@£107 per long ton.

Antimony—Per lb., duty paid, New York: Chinese brands, spot and forward, 13½@13¾c.; Cookson's "C" grade, 17½c. Market continues quiet. Needle and oxide nominally unchanged from quotations in the Dec. 4 issue.

Bismuth—Per lb., New York, in ton lots, $2.70@$2.75. London, 10s.

Cadmium—Per lb., New York, 60c. London, 1s. 10½d.@1s. 11d. for American metal; 1s. 10d. for Australian metal.

Iridium—Per oz., $120@$125 for 98 @99 per cent sponge and powder. Firm. London, £32½ in iridio-platinum; £17@ £24 for sponge and powder. Nominal.

Nickel — Per lb., ingot, 35c.; shot, 36c.; electrolytic, 39c. (99.75 per cent grade). London, £170@£175 per long ton according to quantity.

Osmium—Per oz., $70@$80. London, £16@£19.

Palladium—Per oz., $68@$72. Pure metal as a constituent of crude platinum, $55@$60 per oz. London £12@ £13, nominal.

Platinum — Official price on refined metal, $112 per oz. Open market cash sales of large lots, $107. Pure metal as a constituent of crude platinum, $106. Market dull.

London, £23 per oz. for refined and £20½ for crude. Dull.

Quicksilver—Per 75-lb. flask, $99. Small lots bring $100. San Francisco wires $98.67, steady. London, £17¼@ £17½.

Ruthenium—Per oz., nominally $50@ $60. London, £7½@£11.

The prices of **Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Monel Metal, Radium, Rhodium, Selenium, Tellurium, Thallium, Tungsten,** and **Zirconium** are unchanged from the issue of Dec. 4.

Metallic Ores

Manganese Ore—Per long ton unit of Mn, c.i.f. North Atlantic ports, minimum 47 per cent Mn, 32@34c. Caucasian (washed), 53@55 per cent, 38@ 40c. The market is firmer on account of smaller imports.

[1]Chemical grades, powdered, coarse or fine, 82@87 per cent MnO_2, Brazilian and Cuban, $70@$80 per ton in carloads.

Tungsten Ore — Per unit of WO_3, N. Y.: Wolframite, $10.65@$10.90; Western scheelite, $11.25@$11.50.

Chrome, Iron, Molybdenum, Tantalum, Titanium, Uranium, and Vanadium Ores are unchanged from quotations in the Dec. 4 issue.

Zinc Blende Price Lower; Lead Ore Unchanged

Joplin, Mo., Dec. 4, 1926

Zinc Blende

High	$51.70
Premium blende, basis 60 per cent zinc	$47.00@ 48.00
Prime Western, basis 60 per cent zinc	46.00
Fines and slimes, 60 per cent zinc	45.00@ 43.00
Average settling price, all zinc	46.13

Galena

High	$103.75
Basis 80 per cent lead	100.00
Average settling price, all lead	102.77

Shipments for the week: Blende, 16,547; calamine, 102; lead, 3,508 tons. Value, all ores the week, $1,127,000.

With the reduction of $1 per ton in zinc prices this week, sellers have started to create a sentiment favoring restriction of output. It may result in closing down a few of the mines for two or three days around Christmas. There has been a quiet restriction, not blazoned to the public, by which production has been lowered nearly 2,000 tons from the peak attained in October. Buyers have just awakened to this, and report but little unsold ore in the bins of producers.

Lead buyers succeeded in again dipping into the reserve stock of lead, securing approximately 1,300 tons of concentrate that had been held for an advancing market.

Platteville, Wis., Dec. 4, 1926

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$49.75

Lead Ore	
Lead, basis 80 per cent lead	$101.00

[1]Price furnished by Foote Mineral Co., Philadelphia.

Shipments for the week: Blende, 1,684 tons; lead, none. Shipments for the year: Blende, 53,242; lead, 1,766 tons. Shipments for the week to separating plants, 2,466 tons blende.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fuller's Earth, Fluorspar, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystals, Silica, Spodumene, Sulphur, Talc, Tripoli, and **Zircon** are unchanged from prices in the Dec. 4 Issue.

Mineral Products

Arsenious Oxide (White Arsenic)— 3½c. per lb. London, £16 per long ton for 99 per cent Cornish white.

Calcium Molybdate, Copper Sulphate, Sodium Nitrate, Sodium Sulphate (Salt Cake), and **Zinc Oxide** are unchanged from prices in the Dec. 4 issue.

Ferro-Alloys

Ferromanganese — Domestic, 78@82 per cent, $100 per long ton, furnace, for delivery during first half of 1927. Imported alloy, $100, duty paid. Market active. Spiegeleisen, 19@21 per cent, $40 f.o.b. furnace; 16@19 per cent nominal at $39.

Ferrocerium, Ferrochrome, Ferrophosphorus, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferro-uranium and **Ferrovanadium** are unchanged from prices in the Dec. 4 issue.

Metal Products

Rolled Copper—Sheets, 22c.; wire, 15⅝@15¾c.; f.o.b. mill.

Lead Sheets—Full rolled, per lb., 11¾c.; clipped, 12c.

Nickel Silver—29¼c. per lb. for 18 per cent nickel Grade A sheets.

Yellow (Muntz) Metal—Dimension sheets, 19⅝c. per lb.; rods, 16⅝c. per lb.

Zinc Sheets—11½c. per lb., f.o.b. mill. Down ¼c.

Refractories

Fireclay Brick, Chrome Brick, Magnesite Brick, Silica Brick and **Zirkite** are unchanged from quotations in the Dec. 4 issue.

Steel Firm—Pig Iron and Coke Dull

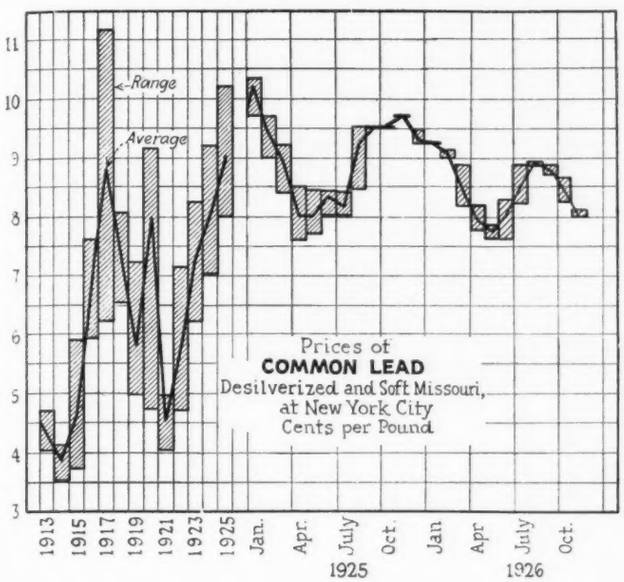
Pittsburgh, Dec. 7, 1926

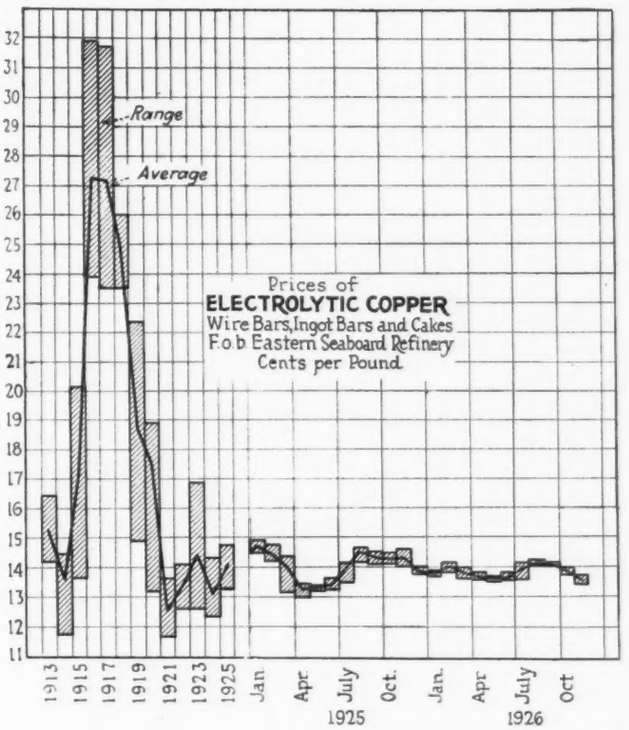
Steel-mill operations are decreasing, but at a slow rate, and as far as can be seen there is no more decrease than should be expected from seasonal influences.

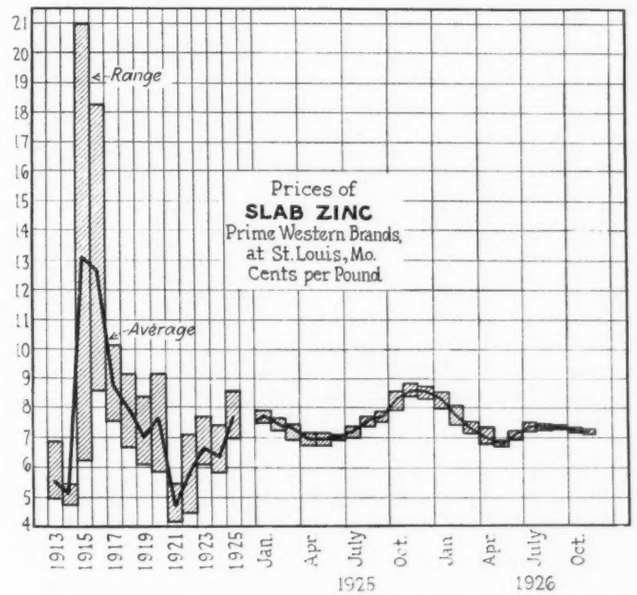
Pig Iron—The Valley market remains very dull, and in this it now has the company of other districts. Bessemer, $20; basic, $18.50; foundry, $19@$20, f.o.b. Valley furnaces.

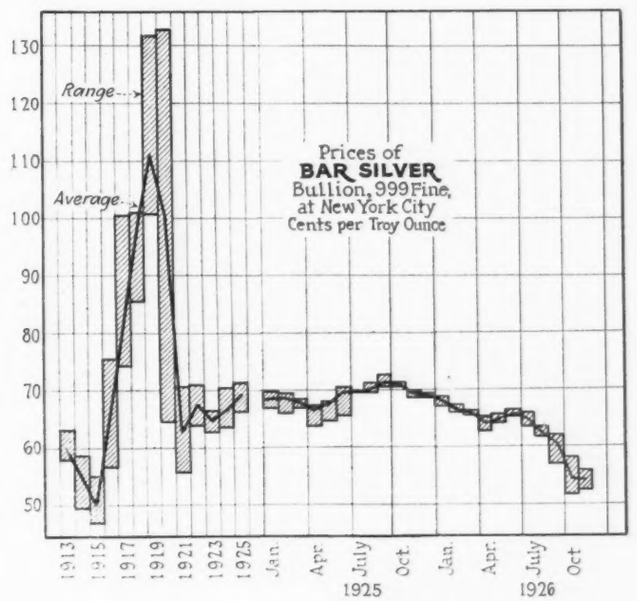
Connellsville Coke—With light offerings and still lighter demand, spot furnace coke is off 50c., at $3.75@$4, foundry remaining at $5@$5.50.

Metal Price Curves

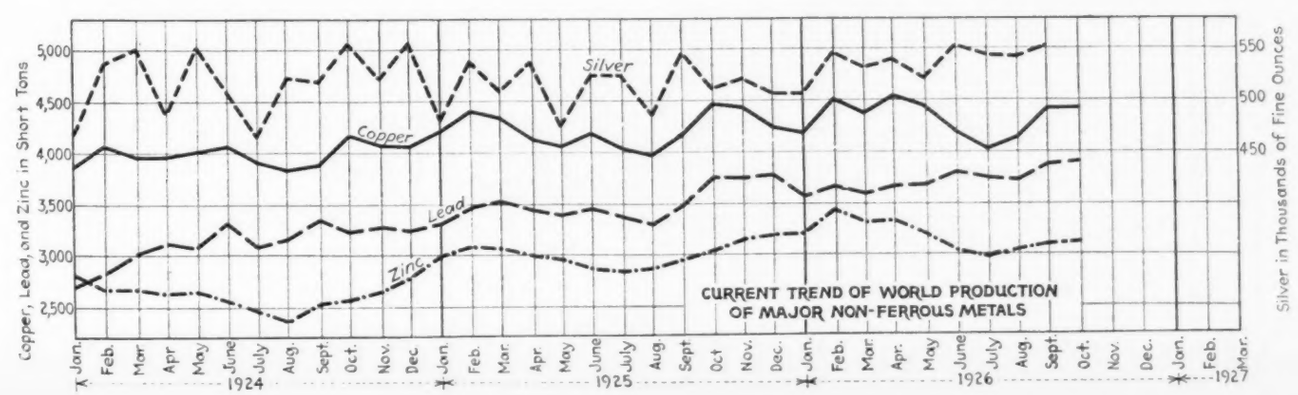



Range
Average
Prices of
ELECTROLYTIC COPPER
Wire Bars, Ingot Bars and Cakes
F.o.b Eastern Seaboard Refinery
Cents per Pound
1913 1915 1917 1919 1921 1923 1925 Jan Apr July Oct. Jan. Apr July Oct
1925 1926





THE curves below are not to be considered as permanent records of production. They show merely the current trend in terms of daily output, according to latest estimates of the American Bureau of Metal Statistics. The figures represent countries that produced in 1924 and 1925 about 97 per cent of the world's output of copper; 78 per cent of the lead; 87.5 per cent of the zinc; and 81 per cent of the silver.


Copper, Lead, and Zinc in Short Tons
Silver in Thousands of Fine Ounces
Silver
Copper
Lead
Zinc
CURRENT TREND OF WORLD PRODUCTION
OF MAJOR NON-FERROUS METALS
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept Oct Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar.
1924 1925 1926 1927

Review of Current Statistics

By E. H. Robie
Assistant Editor

THOUGH the *Engineering and Mining Journal* Weighted Index of Non-Ferrous Metal Prices dropped further in November, going below the low point of April, 1925, the decline was only about two points, compared with about three in October. Silver was not to blame this time, the November price being little different from that of October; copper and lead were the bad actors. Copper prices have been receding with gradually increasing speed since last August, when a high of 14.275c., refinery, was reached; the present price is about a cent under that level. The same may be said for lead, the price of which receded from close to 9c. in August to 8c. at the end of November. Zinc has changed little recently, keeping between 7 and 7¼c., St. Louis, for about six months now, though it has been sagging a little early in December. Tin is very slightly higher, and the closely controlled metals, nickel and aluminum, pursue the even tenor of their way at 35 and 27c., respectively.

By referring to the black lines on the chart on the opposite page it will be observed that the price index declined for only three months in 1925 before an upward movement began; and in the spring of the current year the recession proceeded for five months. The current decline has proceeded for three months, with the probability that it will continue into December. Will it turn upward then, in a month or two, or is the decline to be a long one? Much depends on how well industrial activity keeps up after the holidays. Manufacturers are playing safe and buying ahead even less than heretofore, so if good business in the late winter and early spring seems reasonably assured, January and February should see active metal markets, with higher prices. On the other hand, little optimism can be gained by inspection of the course of prices during the first four months of either 1925 or 1926.

Perhaps a student of the situation can get a little light by studying the course of the stock market, which is supposed to discount the future. Certainly, no fault can be found with the way the metal shares behaved in November. Take the first group of mining, smelting, and manufacturing companies for example: every one of the seven advanced, turning the curve again sharply upward. The best advance was made by U. S. Smelting, market followers evidently having decided that the company was not going to the dogs after all, just because silver dropped 10c. or so an ounce. But how about the coppers, with copper prices well below the 1912-13 level and still going down; surely they have been weaker? Not at all. Three copper companies increased their dividends in the November payments, and on the day that this is being written two more companies announce increased disbursements in future. Of the thirteen companies whose share quotations enter into the curve on the next page, nine advanced during November, Granby being the market leader. The copper industry has become resigned to an immense production at low prices, and in making money by cutting production costs. For once the triumph is for the mining and metallurgical engineers rather than for the sales forces.

E.&M.J. Weighted Index of Non-Ferrous Metal Prices

100 Is Composite for 1922-3-4

1920	130.92
1921	80.80
1922	93.94
1923	103.43
1924	102.63
1925	134.38
Average 11 months, 1925	111.52
Average 11 months, 1926	108.23

	1925	1926
April	104.75	105.93
May	105.34	105.43
June	107.19	106.68
July	108.81	109.08
August	113.61	110.22
September	114.66	109.27
October	115.64	106.20
November	116.69	104.21

The miscellaneous group of gold-silver-lead-zinc companies also did well in a market way, the shares of eight companies advancing while declines were registered for only three; two closed the month unchanged. Should the general commodity price level gradually decline in the coming months, as the preponderance of opinion seems to consider likely, the gold-producing companies should benefit.

Non-metallic prices show little change, and the index of these commodities is unchanged from October. Feldspar is again somewhat stronger, with a good demand reported by most producers. The advance here, however, is offset by another slight decline in magnesite prices reported out on the Coast.

Copper tonnage statistics show no unusual trends. The average daily production of refined metal in North and South America declined a little in September, and still more in October, but it is too early yet to say that the cut will become of moment. Shipments to domestic consumers have declined to an even greater extent in these two fall months, but this may be attributable to the fact that manufacturers are carrying smaller stocks of raw materials, as they usually aim to do when prices are declining. The rate of exports took a moderate jump in October, but too much encouragement should not be derived therefrom, as dealers were probably laying in stocks abroad in preparation of higher prices with the new export association functioning. How good their judgment was is now a historical matter that they are probably trying to forget. Stocks of refined and blister have been substantially static for a year and a half or more.

The stocks of zinc, which had been declining since last May, kept substantially the same throughout November. This was fortunate, as they were getting dangerously low—equal to only about a week's production, so that a premium was beginning to be asked on prompt shipment. The rate of domestic production and consumption has shown little change in the last two or three months.

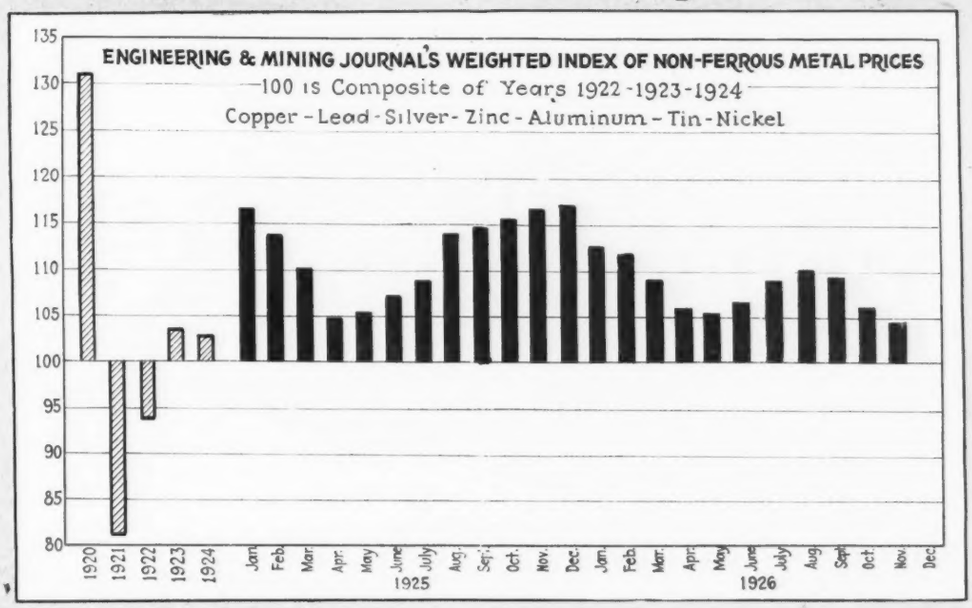
Production rate of United States lead mines again increased, to a new record of 1,870 tons a day, and the trend of world production also continues upward into new high ground. Perhaps recent declines in price will arrest this tendency in the future. Smelter and refinery stocks in the United States and Mexico have changed but little recently.

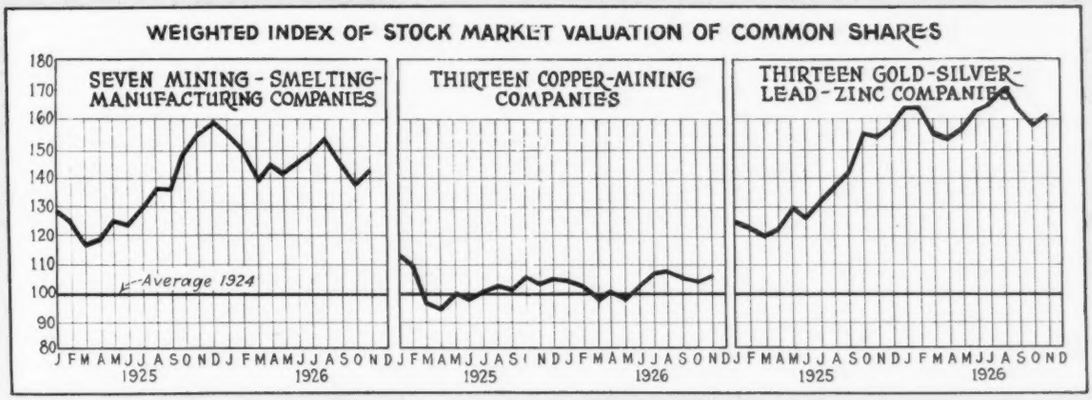
Silver production has been difficult to estimate recently, on account of lack of knowledge of the Mexican output. Without doubt, the lower prices of this metal will affect production adversely, but data are not yet sufficient to indicate to what amount.

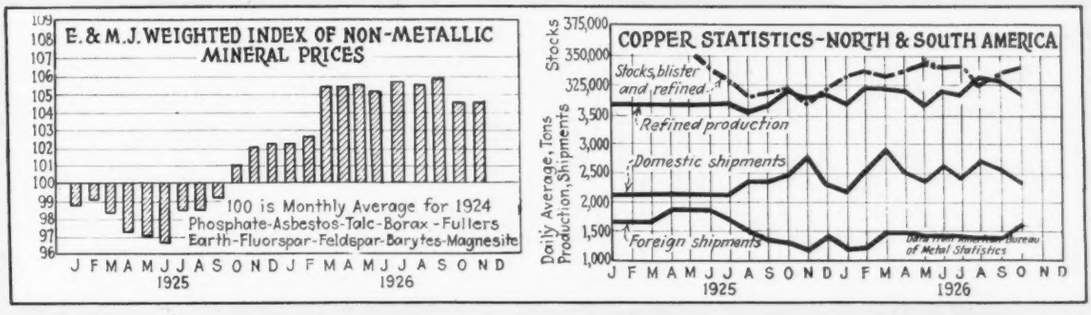
One phase of the silver situation is this: many ores are worth approximately as much for their silver as for their lead, zinc or copper; or at least the silver is a very important source of income. It is a misconception to think that all of the so-called lead and zinc mines will continue to dump "byproduct" silver on the market regardless of the price realized. It is possible that the decline in the silver price, particularly in conjunction with lower prices for base metals, may result in curtailment or suspension by some producers. The consequent diminution of output would tend to strengthen the prices for all the metals. This of course is not a pleasant procedure for those who must do the curtailing or shutting down.

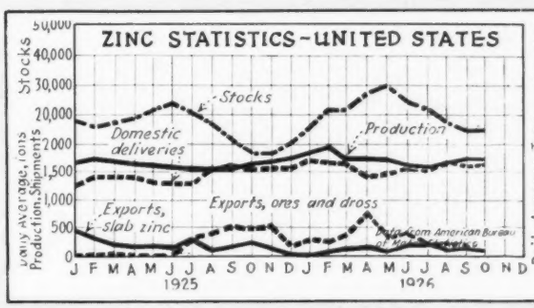
A word might well be said here regarding arsenic and antimony. Stocks of refined arsenic have declined in every month since March, and whereas they amounted to over 7,000 tons last year, they were down to 2,648 at the end of September. Stocks of crude have declined slightly also, being 2,959 at the end of September. The price has held steady at 3½c. for a long time, but with the improved statistical position of the commodity, some improvement may be noted before long, as certainly no one would be tempted to increase production at 3½c. a lb. With regard to antimony, the American Bureau of Metal Statistics has recently begun the compilation of statistics which show the greatly increased consumption of this metal in the United States. The monthly rate in 1923 was only 1,518 tons, advancing to 1,722 tons in 1924, 2,081 in 1925, and 2,444 tons so far in 1926. Tin consumption has also increased moderately, though a scarcity of supplies, with accompanying high prices, has had a slightly retarding effect. Practically no articles have much tin in their composition, however, and high prices do not restrict consumption to the extent that would be true of some other metals.

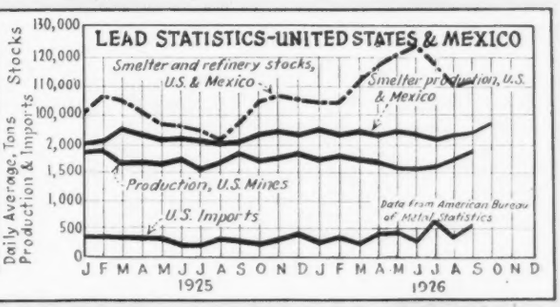
E.&M.J. Statistics of the Mining Industries


ENGINEERING & MINING JOURNAL'S WEIGHTED INDEX OF NON-FERROUS METAL PRICES
100 is Composite of Years 1922-1923-1924
Copper - Lead - Silver - Zinc - Aluminum - Tin - Nickel
1920 1921 1922 1923 1924
1925
1926




E. & M.J. WEIGHTED INDEX OF NON-METALLIC MINERAL PRICES
100 is Monthly Average for 1924
Phosphate-Asbestos-Talc-Borax - Fullers Earth-Fluorspar-Feldspar-Barytes-Magnesite
1925
1926




LEAD STATISTICS - UNITED STATES & MEXICO
Stocks
Daily Average, Tons Production & Imports
Smelter and refinery stocks, U.S. & Mexico
Smelter production, U.S. & Mexico
Production, U.S. Mines
U.S. Imports
Data from American Bureau of Metal Statistics
1925
1926

Mining Stocks—Week Ended December 4, 1926

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	48	47¼	48	Oc.16, No.22 Q	0.75
Arcadian Consol.	Boston	*90	*80	*80		
Ariz. Com'l	Boston	*10	*10	*10	Jy. 16, Jy. 30	0.50
Calaveras	N. Y. Curb			1⅛		
Calumet & Arizona	New York	70	65	66½	De. 3, De. 20Q	1.50
Calumet & Hecla	Boston	16⅞	15⅞	16½	No.30, De.15	0.50
Cerro de Pasco	New York	63¼	62¼	62⅝	Oc. 14,No.1, Q	1.00
Chile Copper	New York	32⅝	31½	32⅝	De.1,De.27, Q	0.62½
Chino	New York	25½	25⅛	25⅛		
Con. Coppermines	N. Y. Curb	3⅞	2⅞	3		
Copper Range	Boston	14¾	14¼	14½	May, 1925	1.00
Crystal Copper	Boston Curb	*38	*30	*33		
East Butte	Boston	2⅛	2¼	2¼	Dec., 1919	0.50
First National	Boston Curb	*5	*5	*5	Feb., 1919	0.15
Franklin	Boston	*31	*30	*30		
Granby Consol.	New York	35⅞	34½	35⅛	May, 1919	1.25
Greene-Cananea	New York	28⅛	25⅞	28	Nov., 1920	0.50
Hancock	Boston			*50		
Howe Sound	New York	40⅛	39⅛	40	Oc.1, Oc.15 Q	1.00
Inspiration Consl.	New York	27	26⅛	27	De.16, Ja.3, Q	0.50
Iron Cap	Boston Curb			3		
Isle Royale	Boston	11¼	11	11	No. 30, De. 15	0.50
Jerome Verde Dev	N. Y. Curb			48		
Kennecott	New York	63¾	61⅛	61⅞	De. 3, Ja. 2 Q	1.25
Lake Copper	Boston	*90	*90	*90	June, 1925	0.50
Magma Copper	New York	36⅝	36	36⅛	Oc.1,Oc.15,Q	0.75
Mason Valley	N. Y. Curb	2⅛	2	2		
Mass Consolidated	Boston	*26	*15	*15	Nov., 1917	1.00
Miami Copper	New York	16⅝	15⅞	15⅞	No.1, No. 15 Q	0.37½
Mohawk	Boston	42⅛	40⅛	40⅛	Oc.30, De 1 Q	2.00
Mother Lode Coa	New York	5	4⅝	4⅝	Jn. 15, Jn. 30	0.37½
Nevada Consol.	New York	16⅛	15⅞	16	De.15, De.31Q	0.37½
New Cornelia	Boston	22¾	22⅛	22⅛	No.5, No.22 Q	0.50
Noranda	N. Y. Curb	21	19⅞	20⅛		
North Butte	Boston	2⅜	2⅛	2 1/16	Oct., 1918	0.25
Ohio Copper	N. Y. Curb	*39	*35	*38	Se. 1, Se. 15	0.05
Old Dominion	Boston	16½	15½	15½	Dec., 1918	1.00
Phelps Dodge	Open Mar.	†135	†132		Se.25, Oc.2 Q	1.50
Quincy	Boston	17⅞	17⅛	17⅛	Mar., 1920	1.00
Ray Consolidated	New York	16½	16⅛	16⅜	Ap.20, Ap.30	0.25
Ray Hercules	N. Y. Curb			11⅝		
St. Mary's Min. Ld.	Boston	27	25½	25½	Ap.17, My.18	2.00
Seneca Copper	New York	3⅜	3	3		
Shannon	Boston	*31	*29	*29	Nov., 1917	0.25
Shattuck-Denn	Boston Curb	6½	6	6⅛		
Superior & Boston	Boston	*20	*20	*20		
Tenn. C. & C.	New York	11⅛	10⅞	10⅞	No.30, De.15, Q	0.25
United Verde Ex	N. Y. Curb	24½	23⅞	23⅞	Oc.16, No. 1, Q	0.75
Utah Copper	New York	113	113	113	De.15,De.31 Q	1.50
Utah Metal & T	Boston	1¼	1¼	1¼	Dec., 1917	0.30
Victoria	Boston			*65		
Walker Mining	Salt Lake	*85	*75	*83		
NICKEL-COPPER						
Internat. Nickel	New York	39¼	36⅞	37⅜	Se.7, Se.30, Q	0.50
Internat. Nickel, pfd.	New York	103¼	103¼	103⅛	Oc.14, No.1,	1.50
LEAD						
Gladstone Mtn	Spokane	*30⅞	*29	*29⅛	Nov., 1926	0.005
National Lead	New York	161⅛	155	160	De.10, De 31 Q	2.00
National Lead pfd.	New York	117⅞	116⅛	117⅛	No.19,De.15 Q	1.75
St. Joseph Lead	New York	42⅜	40⅛	41⅛	Sept., 1926 QX	0.75
ZINC						
Am. Z. L. & S	New York	8⅛	7	8⅛	May., 1917	1.00
Am. Z. L. & S, pfd.	New York	48	41	48	Nov., 1920	1.50
Butte C. & Z	New York	4⅞	4⅜	4⅜	De.10, De.24	0.50
Butte & Superior	New York	13¼	12⅞	13⅛	De.15, De.31Q	0.50
Callahan Zn-Ld	New York	1⅞	1⅞	1⅝	Dec., 1920	0.50
Eagle-Picher	Cincinnati	28⅛	27⅝	27⅞	Au.14,Se.1 Q	0.40
Eagle-Picher, pfd.	Cincinnati			100	Se. 30, Oc. 5 Q	1.50
New Jersey Zn	N. Y. Curb	186	182	186	No.20, De.10 X	2.00
United Zinc	N. Y. Curb			*70		
Yellow Pine	Los Angeles	*15	*14½	*15	Dec. 1925 Q	0.04
GOLD						
Alaska Juneau	New York	1⅛	1⅛	1⅛		
Argonaut	Toronto	*58	*56	*56⅔		
Barry-Hollinger	Toronto	*90	*85	*89		
Carson Hill	Boston	*25	*20	*20		
Consol. W. Dome L.	Toronto	*23½	21½	*23		
Cresson Consol. G.	N. Y. Curb	2½	2½	2½	Oct, 1926	0.10
Crown Reserve	Toronto			*9⅜	Jan., 1917	0.05
Dome Mines	New York	12⅞	11	11⅛	Se.20,Oc.30,Q	0.50
Golden Center	N. Y. Curb	2	1⅞	2		
Golden Cycle	Colo Spring			2	No.30, De.10 Q	0.04
Hollinger Consol.	Toronto	19.00	18.85	18.85	No.16, De.2 F	0.10
Homestake Mining	New York	62½	62	62½	No.20,No.26 M	0.50
Kirkland Lake	Toronto	*83	*79	*83		
Lake Shore	Toronto	14.40	14.00	14.05	De.2,De.15 X	0.20
McIntyre-Porcupine	New York	25	24⅞	25	No.1, De.1 Q	0.25
Newray	Toronto	*38⅛	38¼	*38¼		
Night Hawk Pen	Toronto	*7	*4	*6		
Portland	N. Y. Curb			*43		
Rand Mines	New York			41⅞	Au.23-30Am.Sh.	1.52
Teck-Hughes	Toronto	4.90	4.75	4.85	Jy. 15, Au. 2	0.05
Tom Reed	Los Angeles	*39	*35	*39	March, 1926	0.02
Tough-Oakes	Toronto	*61	*59	*60		
United Eastern	N. Y. Curb	*50	*49	*50	July, 1924	0.05
Vipond Cons.	Toronto	1.60	1.53	1.58		
Wright-Hargreaves	Toronto	9.20	8.25	8.00	Se.15, Oc.1 QX	0.07½
Yukon-Alaska Trust	N. Y. Curb			20		
GOLD AND SILVER						
Carnegie Metals	Boston	11⅛	11⅛	11⅛		
Con. Cortez	N. Y. Curb	*4	*3	*4		
Con. Virginia	San Francisco	*8⅛	*5⅛	*7⅛		
Continental Mines	N. Y. Curb			*48		
Dolores Esperanza	N. Y. Curb	*68	*50	*50	July, 1923	0.05
Premier Gold	N. Y. Curb	2	1⅞	2	Se.15, Oc.4 Q	0.08
Tonopah Belmont	N. Y. Curb	2⅝	2⅝	2⅝	Se.15, Oc.1	0.05
Tonopah Extension	N. Y. Curb	*26	*26	*26	Apr. 1925	0.05
Tonopah Mining	N. Y. Curb	3⅜	3⅛	3⅜	Se.30, Oc.27 SA	0.07½
Unity Gold	N. Y. Curb			*30		
West End Consol.	N. Y. Curb			*9	Mar., 1923	0.05
Yukon Gold	N. Y. Curb	*42	*42	*42	June, 1918	0.02

Stock	Exch.	High	Low	Last		Last Div.
SILVER						
Alvarado	N. Y. Curb			1	Oct., 1920	0.50
Beaver Consol	Toronto	*64	*59	*60	May. 1920	0.03
Castle-Trethewey	Toronto	1.16	1.10	1.16		
Coniagas	Toronto	4.50	4.45	4.50	May, 1924	0.12½
Keeley	Toronto	1.56	1.51	1.52	Se. 1, Se.15 SA	0.12
Kerr Lake	N. Y. Curb	*80	*76	*78	Oc. 1, Oc.15 SA	0.12½
La Rose	Toronto	*6	*5⅛	*5⅛	Apr., 1922	0.10½
Lorrain Trout Lake	Toronto	*55	*27	*55	Jy. 2, Jy. 15	0.05
McKinley-Dar.-Sav	Toronto	*12	*10¼	*12	Oct., 1920	0.03
Mining Corp. Can	Toronto	2.88	2.75	2.78	Jy.1, Jy.15 SA	0.12½
Nipissing	N. Y. Curb	6½	5⅞	6⅞	Se.30, Oc.20 Q	0.15
Temiskaming	Toronto	*10	*10	*10	Jan., 1920	0.40
SILVER-LEAD						
Ahumada	New York	5⅜	4⅞	5⅛	De.18,Ja.5, QX	0.15
Alta Merger	Salt Lake	†*4	†*2			
Bingham Mines	Boston	32⅛	31⅛	31⅛	Se.20,Se.30 Q	1.00
Cardiff M. & M	Salt Lake	*25	*25	*25	Nov., 1924	0.10
Chief Consol	Salt Lake	2.90	2.90	2.90	Oc.10, No.1 Q	0.10
Consti'n Mng.&Mill'g	Spokane	*54	*50	*54		
Emma Silver	Salt Lake	†1	†*75			
Erupcion	Boston Curb			1 7/32	De.18, Ja.3, QX	0.10
Federal M. & S	New York	81½	80	81½		
Federal M. & S., pfd.	New York	74	70⅛	74	No.24, De.15 Q	1.75
Hawthorne Mines	N. Y. Curb	*8	*6	*8		
Hecla Mining	N. Y. Curb	16⅛	16⅛	16⅛	No.15,De.15 Q	0.50
Highland-Surprise	Spokane	*22½	*20½	*21½		
Iron King Mining	Salt Lake	*23	*22	*22		
Keystone Mining	Salt Lake	*28	*28	*28	Au.12, Au.26	0.07½
Lucky Jim	Spokane	*14¼	*14¼	*14¼		
Lucky Tiger-Com	Kansas City	†7.40	†7.10		Nov. 20, 1926	0.07
Mammoth Mining	Salt Lake	2.65	2.55	2.55	Mar.24,Apr. 1	0.10
Marsh Mines	Spokane	2⅜	2⅛	2⅛	Se.15, Oc.19	0.15
Park Utah	New York	6.40	6.20	6.20	Se.15, Oc.1 Q	0.15
Plutus Mining	Salt Lake	2.00	1.90	2.00	Oct. 15, Q	0.15
Prince Cons	Salt Lake	*3	*3	*3		
Silver King Coal	Salt Lake	8.45	8.40	8.40	Se. 20, Oc.1, Q	0.25
Silversmith	Spokane	*32	*30	*30	Oc.1, Oc.10 Q	0.02
Strattons Mines	Spokane	*37	*34	*36		
Sunshine M. Co	Spokane	*38	*36	*37		
Tamarack-Custer	Spokane	*48⅛	*44	*44⅛	Sept., 1924	0.25
Tintic Standard	Salt Lake	12.37½	12.00	12.00	De.11, Ja.3	0.30
Utah-Apex	Boston	6	5⅜	5⅜	Oc.3, Oc.15 Q	0.25
Western Utah Copper	N. Y. Curb			*5		
IRON						
Bethlehem Steel	New York	48⅜	46⅜	46⅝	July, 1924	1.25
Cleveland-Cliffs Iron	Cleveland	80	70	78	Oct., 1926	1.00
Colorado Fuel & Iron	New York	45⅜	42⅛	42⅛	May, 1921	0.75
Gt. North'n Iron Ore	New York	19⅝	19⅛	19¼	Dec.6, Dec.28	0.75
Inland Steel	New York	41⅞	40⅛	40⅛	No.15, De.1 Q	0.62½
Mesabi Iron	N. Y. Curb	1.00	*87	1.00		
Replogle Steel	New York	11¼	9⅛	10⅜		
Republic I. & S	New York	56⅜	55⅛	55⅛	No.15, De.1 Q	1.00
Republic I. & S. pfd.	New York	96	95⅜	95⅝	De.15, Ja.2 Q	1.75
Sloss-Sheffield S. & I.	New York	128⅛	125⅜	126	De.10, De.20 Q	1.50
Sloss-Shef. S.&I. pfd.	New York	107	107	107	De.20, Ja.3 Q	1.75
U. S. Steel	New York	150⅜	145⅛	149⅝	De.1, De.30 Q	1.75
U. S. Steel pfd	New York	129⅜	128¼	129	No 2, No.29,Q	1.75
Virginia I. C. & C	New York	52	52	52	Jan., 1924	1.50
Virginia I.C.&C.pfd	New York	82⅛	82⅛	82⅛	De.15, Ja.2,	2.50
DIAMONDS, PLATINUM, ALUMINUM, VANADIUM						
De Beers Consol	New York	31⅛	30⅛	30⅞	Ju.16, Ju.17	1.70
So. Am. Gold & P	N. Y. Curb	3⅛	3⅛	3⅛		
Alum.Co.of Amer	N.Y.Curb	71⅞	70⅛	71⅛		
Alum. Co. of Amerpf.	N.Y.Curb	103⅞	103⅞	103⅞	Oct.1, Q,	1.50
Vanadium Corp	New York	41	39⅜	41	De.1, De.15, X	1.00
ASBESTOS						
Asbestos Corp., New	Montreal	24	22⅛	23⅛	Jan., 1926	1.50
Asbestos Corp., pfd.	Montreal	84	81	83⅜	Jy.1, Jy.15, SA	1.75
SULPHUR						
Freeport Texas	New York	36	31⅝	34⅜	Nov., 1919	1.00
Texas Gulf, new	New York	52⅜	48⅞	49	De.1, De.15, Q	1.00
MINING, SMELTING, REFINING AND GENERAL						
Amer. Metal	New York	46	44⅛	46	No.19, De.1, Q	1.00
Amer. Metal pfd	New York			113⅞	No.20, De.1 Q	1.75
Amer. Sm. & Ref.	New York	136⅞	132	135⅛	Oc.15, No.1, Q	2.00
Amer. Sm.&Ref.pfd.	New York	120	119¾	119¾	No.5, De.1, Q	1.75
Consol. M. & S	N. Y. Curb			300	Jn.30, Jy.5 SA	3.75
Federated Metals	N. Y. Curb	13⅜	13	13⅛		
Newmont Mining	N. Y. Curb	74⅝	74	74⅝	Oc.1, Oc.15, Q	0.60
Southwest Metals	N. Y. Curb	*90	*90	*90		
U. S. Sm. R. & M.	New York	35¼	34⅞	34⅜	Oc.7, Oc.15, Q	0.87½
U. S. Sm. R.&M.pfd.	New York	46	46	46	Oc.7, Oc.15, Q	0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. F, four weeks. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Henry Sachs, Colorado Springs, Colo.

PRICE WEEK ENDED NOV. 23, 1926

Name	High	Low	Last	Last Divd. Date	Amount
Aramayo Mines (25 frs.)	75/—	72/6	75/—	Nov. 1926	15 p.c.†
British Platinum (£1)	3/6	3/—	3/—	Feb. 1925	2½ p.c.
Burma Corpn. (10 rupees)	14/7½	14/—	14/3	Aug. 1926	7 annas*
Bwana M'Kubwa (5s)	7/3	6/9	7/1½		
Camp Bird (2s)	3/6	2/3	2/6		
El Oro (£1)	5/10½	5/6	5/9	Nov. 1924	2½ p.c.*
Esperansa (10s)	—/8	—/6	—/6		
Frontino & Bolivia (£1)	9/—	8/3	9/—	Jan. 1927	5 p.c.
Mexican Corpn. (£1)	10/6	9/6	10/—		
Mexico Mines of El Oro (£1)	21/10½	20/10½	21/3	June 1926	7½ p.c.*
Oroville Dredging (£1)	3/3	2/10½	3/—	Dec. 1923	3¼ p.c.
Ouro Preto (£1)	2/3	2/—	2/3	May 1925	2½ p.c.
Rhodesian Congo Border (£1)	87/6	80/—	87/6		
St. John del Rey (£1)	9/1½	8/9	9/—	June 1925	6½ p.c.
San Francisco Mines (10s)	32/—	30/6	31/6	June 1926	15 p.c.
Santa Gertrudis (£1)	15/3	14/7½	14/9	Oct. 1926	3¾ p.c.
Selukwe (2s. 6d.)	11/9	11/3	11/6	April 1917	6¾ p.c.
S. Amer. Copper (2s.)	4/—	3/7½	3/9	Nov. 1917	75 p.c.
Tanganyika (£1)	43/9	40/3	41/3	Aug. 1926	7½ p.c.
Tomboy (£1)	3/7	3/—	3/6	July 1926	10 p.c.
Union Miniere du Haut-Katanga (Brussels)	8.775	8.510	8.750	July 1926	175 (‡)

* Free of British income tax. † Swiss frs. ‡ Belgian frs. and free of taxation.